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ON THE DEVELOPMENT OF CHILDREN'S DRAWING ABILITY:

The Roles of Spatial Concepts, Representational Concepts, and Drawing Scripts

by

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Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology in the Graduate School of Duke University

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ABSTRACT

(Developmental Psychology)

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The present inquiry was intended to elucidate the development of children's drawing ability. Piaget and Inhelder hypothesized that understanding of three-dimensional spatial relations is highly related to drawing ability. Following Arnheim and Golomb it was hypothesized that three-dimensional spatial concepts are not sufficient to enable children to draw spatial relations; knowledge is also required of a symbolic "language" for representing objects on the two-dimensional page. To test Piaget and Inhelder's hypothesis measures of three-dimensional spatial concepts and of spatial drawing ability were constructed. Performance at two age levels, 6 and 9 years old, was also assessed to evaluate the hypothesis that a shift in cognitive maturity produces differences in drawing ability.

No support was found for Piaget and Inhelder's hypothesis. Many children at both ages demonstrated superior performance on the three-dimensional spatial concepts test, but poor performance on the drawing test. Older children drew better than younger children, but no age differences were found in ability to construct three-dimensional spatial concepts.

Arnheim and Golomb's claim about the role of two-dimensional representational knowledge in drawing was more directly assessed. The hypothesis that training using

representational models improves children's drawing ability at both age levels as compared to simple practice was tested by comparing two training procedures. Pre- and post-test drawing ability was evaluated using the measure previously discussed. The evidence supported the claim for involvement of representational knowledge in drawing ability. Children at both age levels who received this training improved on familiar figures (those practiced during training), but were unable to generalize their knowledge to novel figures.

Interviews were conducted with children of both ages to explore the nature of spontaneous cognitive processes in drawing. Content analysis revealed the most salient characteristics of children's reports: 1) choice of elements, 2) simple and elaborated associations, and 3) representational concepts and production strategies. These results were interpreted as evidence that children develop drawing scripts. Two functions were suggested for drawing scripts, as mnemonics to organize the content and structure of drawings, and as production strategies.

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Writing a dissertation long distance places special burdens upon the advisor. No advisor could have offered more thoughtful guidance or demonstrated more kindness and tact than Dr. Lloyd Borstelmann. Although this inquiry differs in part from Jean Piaget's characterization of drawing development, I believe it supports the enduring contribution of his larger theory. Whatever insight I have gained in the process of this inquiry is due largely to the deep respect and understanding Dr. Borstelmann communicated for Piagetian stage development theory.

Another intellectual debt is owed to Dr. Naomi Quinn who first introduced me to cognitive science in her anthropology courses, and whose advocacy of model-building and the use of children as informants inspired the interview data in the study.

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Any of the remaining errors or omissions are the responsibility of the author.

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Chapter I

INTRODUCTION AND PROPOSAL

The artistic ability of a few select members of our culture is highly valued, but we do not nurture the development of this ability in the majority of people. Our cultural emphasis on mastery, competence and achievement may produce a self-fulfilling attitude about drawing. Most of us feel quite inept at art, and while valuing the arts practiced by the talented few, have no confidence in our own ability to produce competent art work.

This inquiry proceeds from the belief that artistic capability is widespread but requires extensive learning experiences for individual talent to develop. According to this view most adults are capable of artistic production which is both formally sophisticated and meaningful. In addition, currently established developmental norms for children's drawing ability may be inaccurate because children usually lack the learning experiences that would enable them to produce more advanced work. No one suggests that children can learn arithmetic by providing them with a piece of paper, a pencil, and a few examples of addition to look at. The principles of addition and long division are only a few of many mathematical concepts about which children receive detailed instruction. Analogously, a host of concepts involving

a variety of cognitive processes may contribute to the development of drawing ability. A closer examination of some of these concepts and processes can be a first step in delineating some of the knowledge necessary for children's production of realistic drawings. Moreover, psychologists interested in the nature of the development of drawing ability, and more generally in cognitive development, should find interesting the extent and manner to which learning experiences can affect the developmental course of realistic drawing.

The remaining parts of this introduction review the research literature on cognitive processes thought to contribute to children's drawing ability and present a study to examine their role in the development of children's drawing ability. The study investigates the cognitive processing and structure, and the content involved in children's realistic drawing. Three areas of children's knowledge will be examined:

1. The contributions to realistic drawing of knowledge about construction of three- and two-dimensional spatial relations
2. The effectiveness of training children in drawing skills through the use of two-dimensional representational models and drawing practice
3. Children's use of spontaneous cognitive processes during the drawing process.

Two methodological approaches have been used in this study. The first approach uses an experimental design for assessing the role of three- and two-dimensional knowledge in constructing spatial relations, as well as testing the degree

to which drawing ability can be trained. The second approach employs directed inquiry, by interviews with the children themselves to examine the role of spontaneous cognitive processes in children's drawing. These two approaches will be presented separately in both Section II--the design and methods section--and in Section III--the results section. Finally, Section IV summarizes the results, integrating the information from both methodological sources and assessing the implications of these results.

Cognitive Developmental Processes in Children's Graphic Production

Three- and Two-dimensional Drawing Concepts

The dominant traditional explanation of children's drawings is one most closely associated with Piaget's theory of intellectual development--although the concept predates Piaget's work (Luquet, 1927). This tradition's principal claim is that children's drawings reflect their cognitive immaturity. In 1927 Luquet proposed what is now called the "conceptual" hypothesis. According to the conceptual hypothesis, immature cognitive processes underlie children's conception of reality; these processes develop in stages characterized by a necessary sequential order. While the acquisition of "specific structures" through learning is acknowledged, the cognitive immaturity view of children's drawing ability is dominated by the belief in a limited cognitive ability during a given stage of development. Consequently, theorists (Goodenough, 1927; Harris, 1963; Luquet,

1927; Piaget, 1926; Piaget and Inhelder, 1956; Werner, 1948) have maintained that imperfect drawings reflect imperfect higher order knowledge rather than imprecisely perceived characteristics of objects. Literally, children's limited cognitive ability prevents them from incorporating many characteristics of objects into their drawings so that they ". . .draw what they know, not what they see" (Luquet, 1927).

A more recent line of research has attempted to further clarify the nature of specific drawing concepts and processes. These psychologists, referred to herein as graphic theorists, do not necessarily disagree with the idea that drawing is limited by cognitive immaturity or that drawing concepts develop in successive qualitative stages. Instead, they argue that an additional set of concepts is required beyond those offered by the theory of cognitive immaturity to account for the characteristics of children's drawing. Graphic theorists argue that children's drawings are inadequate because children lack concepts particular to symbolization in graphic media (Arnheim, 1954, 1966, 1974; Golomb, 1972, 1973; Goodnow & Levine, 1973; Lewis, 1963). According to this formulation drawing is difficult for children because they must acquire a two-dimensional representational system of graphic "language" in addition to understanding the depicted three-dimensional object. For example, Jacqueline Goodnow and Rochelle Levine have proposed that children use inadequate rules for assembling figure parts (1973). Also, Rudolph Arnheim claims that children experience difficulty in understanding how to adequately symbolize three-dimensional objects

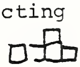
in a two-dimensional medium (1974). Taking into consideration the graphic theorists' position, the following sections will examine three specific claims by cognitive immaturity theorists about the nature of the cognitive processes involved in children's drawings: 1) there is a relationship between drawing ability and intelligence based upon cognitive immaturity, 2) immature children's drawings reflect syncretic thinking or intellectual realism, and 3) children's drawings primarily reflect inadequate three-dimensional spatial concepts.

The Relationship between Drawing Ability and Intelligence

In order to assess children's level of cognitive maturity, Florence Goodenough and Dale Harris devised measures of intelligence based upon norms for drawings of the human figure at different ages. The Draw-A-Man Test and the revised version--Harris' Draw-A-Person Test--have been shown to be reliably correlated with a number of the standard measures of children's intelligence (*r* = approximately, .45). This correlation is significant but accounts for only a limited portion of the common variance between the two measures. While the correlation establishes a positive relationship between drawing ability and intelligence, it cannot demonstrate the nature of the relationship. The evidence presented by Goodenough and Harris cannot make explicit either what kinds of cognitive processes contribute to this relationship or the extent to which any of these processes may be facilitated by learning experiences. Furthermore, if the cognitive

processes involved in drawing ability can be influenced by training, the validity of intelligence tests based upon drawing tasks must be questioned. Since graphic training is not uniformly available to children within our own culture and also varies considerably from one culture to another (Hudson, 1960), individual scores may reflect differential learning experiences rather than individual or cultural differences in capacity to learn.

Three Stages of Cognitive Maturity in Children's Drawings

Luquet (1927) characterized children's drawings as following three successive stages of development: 1) syncretic incapacity, 2) intellectual realism, and 3) visual realism. As Luquet presented them, these stages were primarily descriptive with the first two serving to discriminate the very primitive drawings of early childhood from the inadequate but more sophisticated drawings of middle childhood. The last stage anticipated children's success in depicting objects from a particular point-of-view. The implication that realistic drawing was the purpose of children's endeavors from early childhood was implicit in this description. More recently research has focused upon theoretical explanations for the figures typically drawn by children in the first two stages; the resolution of the "tadpole" figure () into a proper human figure () by children less than 6 years old, and problems with depicting solid objects (e.g., a cube  is drawn as  or ) between 6 and 9

years old.

Syncretic thinking. Cognitive immaturity theorists have claimed that when children are less than 6 years old the characteristics of their drawings result from a cognitive process termed syncretic thinking (Harris, 1963; Piaget & Inhelder, 1956; Werner, 1948). Syncretic thinking occurs when several mental functions that are normally distinct in the adult are merged into one activity by the child. This results in a conceptual confusion in which children are unable to coherently organize their mental representation (Werner, 1948). Drawings in which parts of the figure are simply juxtaposed without apparent organization or joined incorrectly are thought to be the result of syncretic thinking. The classic figure referred to in this argument is the so-called "tadpole" drawing. These figures are drawn without differentiation of the head and torso, and they sometimes lack arms or have arms connected to the head rather than the torso (e.g., ).

Golomb (1972, 1973) has suggested an alternative explanation for these human figure drawings. Deriving her position from Arnheim's work, she proposed that the young child does not yet understand that the pictorial parts symbolize parts of objects, and that the child does not have a concept of how to construct the proper forms of the figure.

Both sides of the syncretism controversy have presented evidence to support their claims. Piaget and Inhelder asked children between the ages of 2 and 7 years old to copy a series of geometric figures. They reported a chronological

sequence distinguished by a qualitative shift in the development of children's three-dimensional spatial concepts on the basis of these drawings. Without detracting from the contribution of Piaget's clinical interview method to psychology, it is important to repeat the well-known criticisms that the investigators' verbal report is open to experimenter bias in interpreting the evidence, and that the sample size is too small to support the hypotheses being investigated. As a result of these problems, Piaget and Inhelder's claims about syncretic thinking cannot be considered established on the basis of their evidence.

In support of her explanation, Golomb suggested that both dictating the parts to be drawn and providing the parts in a manikin assembly task would result in spatially well-organized figures in most children's work. In order to resolve the controversy over syncretic thinking, Wallach and Bordeaux (1976) constructed a test of Golomb's hypothesis. They asked children 2 to 5 years old to both identify and assemble the parts of a manikin figure. Two identification tasks were conducted; the child's imitation of the experimenter wiggling the relevant parts of the body, and verbal labeling of the manikin parts (i.e., head, arms, legs and torso). Identification of the manikin parts was considered correct and precise when a child named the complete part (arm) and correct but less precise when a child named a subpart (finger or elbow) <u>or</u> could only wiggle the part indicated on his or her own body. Identification of the parts was then categorized into five qualitative levels. Assembly of the manikin parts was

categorized as figural if its parts were in an arrangement that produced a plausible two-dimensional human image. A Chi-square analysis indicated a significant relationship between identification of parts and achievement of figural assembly ($p < .001$). The proportion of cases in which children were able to achieve assembly increased steadily along with increased quality of identification. If syncretic thinking had influenced figure assembly the authors would expect to see many children who identified the manikin parts but could not organize them into a plausible human figure. Instead, only 2 of 17 children who demonstrated precise identification of the parts were unable to accurately organize the manikin figure. This data supports Golomb's contention that the tadpole figures thought to result from syncretic thinking may actually be the result of children's inability to both identify the parts of a symbolic figure and to construct the proper forms of the figure. Wallach and Bordeaux found no evidence to support the cognitive immaturity hypothesis of syncretic thinking in children at the age when it is most expected to occur.

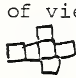
Intellectual realism. According to Eng (1954), Luquet (1927), and Piaget and Inhelder (1956), children enter into a stage of development following syncretic incapacity where the level of cognitive immaturity results in drawing characterized by "intellectual realism." Children between approximately 6 and 9 years old "draw what they know, not what they see" (Luquet, 1927). Clark (1897) illustrates this phenomenon when he refers to children drawing an apple with a pin stuck in it

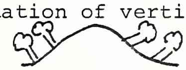
with the pin visible through the apple () instead of the "visually realistic" depiction where the apple occludes the pin (). Again, in this form, this is more of a description of stage development than a theory about the specific nature of the conceptual problems and processes involved in drawing at this age. Only Piaget and Inhelder (1956) have presented a coherent theoretical view of the nature of intellectual realism in children's drawing and the evidence for this view is examined below. Two additional groups of investigators have attempted to offer less powerful explanations for some drawing characteristics at this age and their evidence is also reviewed.

Children's Drawings and Three-dimensional Spatial Concepts

Piaget and Inhelder (1956) claim that intellectual realism occurs when children between approximately 6 and 9 years old enter a stage of cognitive development where inadequate knowledge of three-dimensional spatial concepts is reflected in their drawings. This claim about drawings is made in the context of a larger theory about children's understanding of spatial concepts. However, in the process of using children's drawings as an indicator of the development of spatial concepts Piaget and Inhelder have nonetheless made explicit claims about the nature of drawing inadequacies at this age. The dependence of their theory of spatial concept development upon a theory about the development of drawing ability is demonstrated by the following approach: "... they

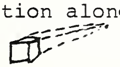
(drawings) enable us to establish the spontaneous character of the structures inherent to representation (mental concepts), which can only later be submitted to detailed analysis by means of more or less artificial experiments. It is entirely from this point of view therefore that we intend to study the problem, and the development of drawing will provide a framework which we can fill in afterward by means of more detailed analysis" (Piaget & Inhelder, 1956, p. 48). In fact most of the subsequent analysis of spatial concepts depends upon tasks that were geometric drawing tasks, two-dimensional construction tasks using matches and flat cut-out pieces, and recognition tasks asking for choices between pictures of objects (pp. 53-4, 172, 212, 218, 221, 381-82). Throughout their discussion of spatial relations Piaget and Inhelder use "representation" to mean three-dimensional mental concepts. Their lack of discrimination between mental concepts for three- and two-dimensional spatial relations is the key to another interpretation of the nature of intellectual realism in children's drawings.

According to Piaget and Inhelder, children at the stage of intellectual realism usually depict "topological" spatial concepts and generally lack the ability to depict "projective" and "euclidean" spatial concepts. Drawings that lack projective characteristics exhibit multiple points of view rather than a single point of view (e.g., a three-dimensional cube is drawn like this: ), and confuse relative locations of objects (e.g., left-right and before-behind relationships are reversed) so that there is no coordination of perspective

in the drawing as a whole. Drawings that lack euclidean characteristics contain incorrect proportions (e.g., relative angle size and length of lines change so that △ is drawn as , and do not indicate knowledge of a three-dimensional reference system with axial coordinates. These latter drawings exhibit distorted distances (e.g., quantification of intervals between objects is inaccurate), and incorrect orientation of verticals (e.g., trees on a hill are drawn like this: ). Presumably, children lacking projective and euclidean spatial concepts would also be unable to depict occlusion, or the concealment of one object by another in front of it (e.g., a circle occluding a square is drawn like this: ). Nor could they place horizon lines behind objects located in the foreplane to indicate the distance to the horizon (e.g.,  , ).

In support of their claims about spatial concepts, Piaget and Inhelder asked children between the ages of 4 and 13 years old to engage in a series of tasks they believed would reveal children's errors in reasoning about the spatial concepts at issue. In almost all cases the spatial tasks were two-dimensional as described above: drawing tasks, construction tasks, and picture recognition tasks. Based upon children's responses to these tasks, Piaget and Inhelder reported a chronological sequence distinguished by qualitative shifts in the development of children's three-dimensional spatial concepts.

Following Arnheim (1974) an additional explanation can be suggested for the drawing characteristics produced by

children of this age. Arnheim has specifically argued that children do not understand how to adequately symbolize three-dimensional objects in a two-dimensional medium. Thus, drawings reflect inadequate representational systems rather than inadequate spatial concepts. The drawing tasks and two-dimensional construction tasks used by Piaget and Inhelder necessarily involve such symbolic knowledge. Following Arnheim's argument, one may claim that children understand that a three-dimensional object is located before or behind another, but do not yet understand how to draw using a representational system such as perspective. For example, children may not know the perspective concept of occlusion (e.g., the shape of the closer figure is complete and interrupts the shape of the further figure so that the further figure is incomplete). Piaget and Inhelder themselves report that children can place trees and men in the proper orientation on the side of a mountain before they can depict the proper orientation of these figures (1956, p. 400). In this case children may lack the perspective concept that the sides of the page can act as a horizontal and vertical reference frame. Similarly, children may understand that a single point-of-view is required but not understand the perspective concept of point-of-view (e.g., side angles of objects are determined by projection along a line of sight to an arbitrary vanishing point: ). Representational systems for the various kinds of perspectives (e.g., standard, isometric, inverted perspective) are quite complex and involve numerous representational concepts. Some of these concepts are probably

more difficult than others (e.g., occlusion may be easier to understand than convergence). Moreover, the principles of perspective are sufficiently abstract to require advanced cognitive development, such as formal reasoning. Consequently, Piaget and Inhelder's implicit assumptions about the nature of drawing ability may underestimate the difficulty of the level of reasoning ultimately involved in drawing.

Only one study (Lewis, 1963) has attempted to test Arnheim's general hypothesis that intellectual realism can be explained in part by children's increasing ability to depict three-dimensional spatial relations within the limits of a two-dimensional medium. Lewis constructed an instrument which she considered to measure increasing accuracy in depicting spatial relations of three kinds. Spherical space was modeled by a ball with a ring around its circumference; cubic space was modeled by a house without a roof; and spatial depth was represented by a dioramic landscape with trees and fences. Children in kindergarten through eighth grade (N = 776) made drawings from the models, which were rated by two independent investigators with agreement of 91.4%. Chi-square tests of the percent of children at each grade level receiving each possible score indicated significant differences in distribution across grade levels for each type of model (spherical space χ^2 (32) = 343.03, $\underline{p}< .001$; cubic square χ^2 (32) = 463.19, $\underline{p}< .001$; spatial depth χ^2 (32) = 399.99, $\underline{p}< .001$). Inspection of the distributions indicated a strongly increasing tendency towards higher scores with an increase in grade level. The increase started with quite low scores at the

kindergarten level and rose gradually to average and high scores at the eighth grade level in all three types of spatial representation.

Lewis concluded that realistic drawing develops from children's increasing ability to render the "structural characteristics of three-dimensional objects within the limits of a two-dimensional medium" (p. 106). While the evidence does support Arnheim's hypothesis about the development of representational competency, it is also consistent with Piaget and Inhelder's hypothesis about the role of children's knowledge of three-dimensional spatial relations in drawing. In addition, it should be noted that Lewis categorizes spatial relations in terms of the general kind of space depicted rather than in terms of a specific representational system available for depicting space. The use of measures of occlusion, convergence, and point-of-view would assess children's knowledge of drawing systems for representing spatial relations--standard Western linear perspective. Finally, there is a change that might be advisable in the selection of study participants. Lewis tended to select children of unusually high intelligence quotients (IQ's) for the study. One school's median IQ was 125 points and the remaining schools had median IQ's of 112, 109, 108 and 107, respectively. Since IQ's are positively correlated with drawing ability, the performance of children at all ages may be inflated and an overestimation of the developmental course of spatial drawing ability.

Two other groups of investigators have offered less extensive explanations for intellectual realism based upon their

own investigations.

Freeman and Janikoun (1972) showed that young children's drawings of a cup included the handle when the cup was situated so the handle was not visible, while older children were able to appropriately omit the handle. Post hoc explanations by the authors suggest that this difference is likely to reflect children's concern that their drawing would not be recognizable as a cup without a handle (a valid concern in this case as a cup without a handle may be seen by themselves or others as a vase). Learning what is expected of a drawing may increase with age, and this may contribute to unrealistic drawings of other noncanonical views of objects. Six and 7 year old children may include properties that cannot be seen from a particular perspective in their drawings because they know a prototype of objects and the prototype dictates what properties should be included to identify them as members of a category (Rosch, 1977). Recognition of expectations for drawings may also indicate increasing recognition that drawing conventions may override previously acquired concepts of object properties.

Phillips et al.(1978) offered two other explanations for intellectual realism in children's drawings. They asked third and fifth graders to label and draw copies of pictures varying in degree of resemblance to a standard cube ( ,  ,  , ), to test the hypothesis that age differences in drawing accuracy were related to children's categorization of the picture being copied. In addition, two drawing techniques were used to assess the influence of

introducing memory for the stimulus into the drawing process. In one condition children looked back and forth between their work and the stimulus picture, and in the other children looked only at the stimulus and were prevented from looking at their own drawings because the drawings were concealed under table-top easels during the copying process.

The authors reported that fifth grade children were significantly better at copying pictures which the children had labeled as objects rather than designs or patterns, while third grade children were thought to be worse at copying pictures labeled as objects rather than designs. Unfortunately, although the authors indicate that Chi-square tests were run to assess age differences, no statistical data is included in the article to verify their claims.

The authors also report that more continuous looking at the stimulus (when children could not see their own drawings) reduces the amount of intellectual realism in children's drawings. Besides the lack of statistical support for this claim, a problem arises in their measurement of drawing ability. Errors created by lack of feedback when copying the stimulus were not counted as errors even though some of these errors were indistinguishable from those resulting when feedback was available. This scoring system would favor drawings made in the continuous looking condition and thus further weakens the authors' claims.

While some interesting explanations for some of the intellectual realism in children's drawings have been presented, the evidence to support these claims is very weak.

A Reevaluation of the Influence of Cognitive Immaturity on Children's Drawing Ability

A stable but limited relationship between intelligence test scores and measures of drawing ability suggests that a variety of cognitive processes, including some that are not tested by intelligence tests, can be contributing to children's drawing ability. A test of the contribution of syncretic processes to human figure drawing could find no support for the cognitive immaturity hypothesis of the contribution of cognitive immaturity to 2 to 5 year old children's drawing ability. Claims that older children's drawings reflect inadequate three-dimensional spatial concepts resulting from cognitive immaturity have yet to be adequately tested. Evidence to support an alternative explanation that children have an incomplete understanding of two-dimensional representational systems is also inconclusive for children ages 6 to 9 years old. If cognitive immaturity does influence young children's drawing ability, it may do so to a degree much less extensive than commonly assumed by cognitive immaturity theorists. At present an examination of the body of research on the cognitive processes contributing to children's drawing ability indicates no adequate support for the exclusivity of the cognitive immaturity hypothesis proposed by cognitive immaturity theorists. In contrast, Wallach and Bordeaux (1976) have presented evidence that children 2 to 5 years old frequently lack the representational concept that two-dimensional shapes on a page symbolize three-dimensional objects. Although this is very limited

support for the role of representational concepts in children's drawings, it does suggest that children may lack additional representational concepts.

In summary, a new proposition can be formulated; knowledge of three-dimensional spatial concepts is necessary but insufficient to enable children to draw spatial relations and incomplete knowledge of two-dimensional perspective systems can account for some of the "errors" in children's drawings usually appearing during the stage of intellectual realism. According to this proposition, the ability to draw spatial relations is not highly related to understanding of three-dimensional spatial relations at either of two age levels. Children just entering the stage of intellectual realism are expected to perform as well as children leaving the stage on measure of three-dimensional spatial relations, even though the higher age level are expected to be better drawers. Furthermore, children's lack of specific representational concepts may not be as limited by their conceptual maturity as Piaget and Inhelder have claimed. One way to test the extent to which cognitive immaturity limits drawing ability is to provide children with learning experiences to improve drawing ability. In this case, drawing training using representational models would be predicted to improve drawing productions as compared to simple practice.

Children's Use of Production Rules for Drawing

A number of researchers (Gesell & Ames, 1946; Goodnow, 1973, 1972; Goodnow & Friedman, 1972; Goodnow & Levine, 1973; Ilg & Ames, 1950; Olson, 1972; Rand, 1973) have investigated the contribution of production rules to children's drawing ability. Researchers have established strong support for the involvement of drawing rules in children's graphic production by examining both the utility of training drawing rules and children's natural use of drawing rules.

The Use of Production Rules Versus Inadequate Perceptual Analysis

There is clear evidence that a lag exists between children's recognition of figures and their ability to produce drawings of these same figures (Ling, 1941; Terman & Merrill, 1937). The child who easily places squares, circles, and diamonds in the correct spaces on a form board, fails to draw accurate pictures of the same simple geometric shapes. Eleanor Maccoby and Helen Bee (1965) have argued that the lag is more apparent than real, and that young children's inability to produce adequate graphic forms is often the result of their inadequate perceptual analysis of the model figures. They proposed the number-of-attributes hypothesis, which states that "To reproduce a figure, the subject must make use of _more attributes_ of the model than are required for most perceptual discriminations" (Maccoby & Bee, 1965, p. 375).

A number of authors (Bee & Walker, 1968; Brittain, 1969; Maccoby, 1968; Olson, 1968, 1970; Rand, 1971, 1973) have since attempted to test this hypothesis. Although most studies report success in improving drawing ability, all but one investigation (Rand, 1973) failed to adequately test the number-of-attributes hypothesis. Most commonly, investigators failed to show that visual discrimination actually improved as a result of the visual training procedures, so that subsequent improvement in drawing ability may have been artifactual rather than due to increased attribute discrimination. For example, after reporting success in training drawing ability, Bee and Walker noted that children made relatively few discrimination errors during their discrimination training (only 43 out of 707 trials). In addition, they could find no relationship between the kinds of post-test discrimination errors found and the errors in post-test drawings.

Fortunately, Colleen Wright Rand (1973) has presented a rigorous test of the contribution of attribute discrimination to drawing ability. Her study compared visual analysis to the ability to use drawing rules in copying geometric figures. Children 3 to 5 years old were assigned to one of three conditions; visual analysis training, drawing rules training, or a control condition. Pre- and post-tests in <u>both</u> discrimination ability and copying ability were administered to each child. An analysis of variance showed that children who received visual analysis training did improve significantly ($p < .001$) in visual attribute discrimination. These same children did not improve in drawing accuracy. Instead, these

children produced significantly less accurate copies of two of the figures--triangles and diamonds. Contrary to the number-of-attributes hypothesis, the lag between children's perception and production of graphic figures does not seem to be due to their inability to sufficiently discriminate enough attributes of the model.

Rand did find that children improved their drawing accuracy following trailing to plan their drawings. A simple rule for dot-connection was taught to 3 to 5 year olds; they were told to place a dot on the page corresponding to each corner of the figure and to connect the dots with straight lines to complete the figure. Rand's children used the rule to successfully improve drawings of both familiar and novel geometric figures. In summary, Rand's evidence supports both the contribution of rules and the success of training in improving drawing ability.

Evidence for Spontaneously Occurring Production Rules

In another study, Goodnow and Friedman (1972) studied children's rules for the orientation of figures upon the page. By presenting children with incomplete figures located at the bottom of the page, they were able to show that children did complete the figures in an orientation that was consistent with the figure parts even though upside-down on the page. They concluded that young children do use rules that orient parts relative to each other, but only later take into account

the orientation of the figure on the page. Young children's natural use of this orientation rule is consistent with the argument presented earlier (p. 4) that young children lack the symbolic knowledge to represent three-dimensional spatial relations. In this case the children may lack the representational concept that the sides of the page can act as a horizontal and vertical reference frame thereby establishing the page itself as a reference point for orientation.

Finally, a number of researchers have shown that children exhibit consistent directionality in their graphic constructions (Gesell & Ames, 1946; Goodnow, 1978; Goodnow & Levine, 1973; Ilg & Ames, 1950; Ninio & Lieblich, 1976). By directionality the authors mean that figures are drawn with movements that pursue a characteristic course--always start at the top, draw all verticals from top to bottom, draw horizontal lines from left to right (depending upon age and culture of child). This directionality is believed to result in simple construction errors, particularly in learning to write the alphabet. Moreover, directionality in drawing can account for drawing errors in standard tests of drawing ability. For example, if a child has a rule that all lines are either vertical or horizontal then the triangle figure used in many intelligence tests may be copied like this:  .

The significance of natural concepts such as orientation upon the page and directionality in drawing, and representational concepts in general, may be more readily understood in the context of a model for spontaneously occurring cognitive processes.

Nelson (1980) has argued that most traditional models of developing knowledge represent static, abstract categorical knowledge. For example, children are able to abstract general categories from kinds of things (e.g., bears, rabbits, and pigs are all animals). Nelson claims that traditional theories of cognition relate "... like elements in linear fashion at different levels of a hierarchy, specified in terms of features or attributes which give rise to coordinate sub-ordinate and super-ordinate relations in taxonomic and paradigmatic schemes" (p. 3). In order to expand traditional models of cognitive processes she draws our attention to a group of researchers including cognitive psychologists, linguists, cognitive anthropologists and researchers in artificial intelligence who in the last 15 years have begun to regard themselves as "cognitive scientists" (Lakoff, 1980; Miller & Johnson-Laird, 1976; Minsky, 1975; Nelson, 1980; Nelson & Gruendel, 1979; Quinn, 1976, 1981; Rummelhart & Ortony, 1977; Schank, 1980; Schank & Abelson, 1977). Cognitive scientists are interested in spontaneously occurring complex cognitive phenomenon and in particular, the dynamic and holistic nature of schemas they hypothesize as relating diverse conceptual elements in a variety of relationships.

One form of event representation that has been studied by cognitive scientists interested in spatial location, story telling, games and social events, is the script. The notion of the script has evolved from that of an "ordered sequence of actions appropriate to a particular context and organized around a goal" (Nelson, 1980), to a particular form of memory

organizing packet (MOP). According to Schank (1980) a MOP is a dynamic reconstruction process driven by the needs or goals of the situation. The reconstruction process enables people to generate memory structure by reintegrating "chunks" of information of many different kinds on a number of levels with the potential to subsume all prior remembered experience. What is thought to make a script a special form of MOP is the reintegration of information from a group of experiences into a sequence of events ordered by time and enablement conditions. Schank gives as an example a restaurant script where the following time sequence of enabling events is generated to accomplish eating at a restaurant; "entering, seating, ordering, eating, paying, leaving" (1980, p. 271). Time-ordering refers to the sequence in time that an actor would follow in enacting this script (e.g., first entering, then being seated et cetera.). Enabling conditions are not explicitly defined by Schank but generally refer to any knowledge necessary to result in the desired activity. For example, being seated may involve knowing how to interact with the head waiter or hostess which in turn may require information about how to identify your reservation, the number of people in your party, and acceptance or refusal of the choice of table.

That children spontaneously develop scripts for drawing activity seems a plausible proposition. This proposition was arrived at as a consequence of the content analysis of children's interviews. The way in which drawing scripts can contribute to children's drawing activity will be briefly illustrated here through a reinterpretation of the evidence for

spontaneously occurring cognitive processes. A more complete discussion based upon an analysis of the children's interviews is presented in the final chapter which discusses the contribution of drawing scripts to the development of their drawing ability.

Two examples previously discussed of spontaneously occurring cognitive processes in children's drawing may be understood in terms of the structure and qualities of these kind of scripts. For example, directionality in drawing may result from children creating scripts for drawing geometric figures with a time-ordered sequence of events (e.g., always start at the top) and knowledge of different kinds of enabling acts (e.g., horizontal lines should be drawn from left to right). In the other instance, the peculiar orientation of upside-down orientation of the human figure upon the page may result from an incomplete script for location of the vertical. Early scripts may indicate that orientation is relative to the principal figures in a picture, and only in later scripts does proper orientation require two reference points--the principal figures and the orientation established by the page (see discussion, p. 23).

Other characteristics of scripts may exemplify qualities of the cognitive processes involved in children's drawing activity. The way in which scripts are organized is significant. As indicated above, drawing scripts may be characterized as a dynamic reordering and reconstruction of chunks of information in both hierarchical and non-hierarchical structures. Evidence for this kind of quality in drawing scripts might be

either of the following. The same head shape can be drawn with many kinds of facial expressions. The upper torso can have "running" legs substituted for "walking" legs. Both of these exemplify hierarchical organization in a dynamic process because faces are subordinate members of "heads" category and similarly legs are subordinate parts of the human figure. A non-hierarchical structure would be the use of the same tree figure in a number of different kind of landscapes. In this case the tree can exist independently of the landscape and landscapes do not necessarily include trees.

Drawing scripts also may more accurately model the content of drawing processes. Scripts are thought to contain more of what is referred to as characteristic rather than simply definitional knowledge. This means that the kind of information relevant to the conceptual task of script formation consists of anything that might be known about the problem rather than consisting of only defining knowledge arrived at through inductive and deductive processes. For example, a familiar instance of a hospital might influence the content of a hospital drawing script. A cafeteria, atrium, or religious chapel might belong in such a drawing script even though the definition of a hospital does not usually include this kind of content.

There is insufficient empirical evidence to support the assumptions of cognitive immaturity theorists that the characteristics of children's drawing are primarily the result of either syncretic thinking at 2 to 5 years old, or the lack of three-dimensional spatial concepts between 6 and 9 years of

age. Instead, the inadequacies in children's drawings have been explained more consistently by their lack of representational concepts at the younger age range and their use of inadequate production rules in both age groups. Following the "graphic theorists," the proposition set forth herein is that the characteristics of drawings done by children in the older age range also may be explained by children's lack of representational concepts. Specifically, the argument maintains that children in the age range between 6 and 9 years are in the process of acquiring perspective concepts such as occlusion, convergence, and point-of-view. Furthermore, the model of cognition proposed by cognitive scientists may be applied to drawing activity. The proposition that children develop drawing scripts seems an especially useful means of describing the structure and qualities of cognitive processing involved in the development of children's drawing ability.

Finally, some evidence has been presented that the younger children can improve their drawing ability by learning drawing rules. This supports the present argument that the specific cognitive structures involved in drawing may be acquired to some extent by learning experiences which children in general, but particularly younger children, do not usually receive.

A Cognitive Developmental Model of Children's Drawing Ability

The model proposed herein is that representational concepts and production rules are two intimately related parts of the cognitive processes which contribute to graphic production. According to this model the relationship between concepts and rules is a bidirectional one: representational concepts influence the selection of production rules, and the use of production rules gives insight into the conceptual system that underlies a graphic solution. The end goal of such cognitive processes is the creation of a style useful for solving graphic problems (e.g., perspective systems, cubism, impressionism). The mature artist may use only one representational system with a variety of production rules, or a group of representational systems with a wide range of production rules. In contrast, children may know fewer appropriate representational concepts and production rules than mature artists. Their graphic productions may be characterized as resulting from concepts and rules which are incomplete, inaccurate, unrelated, or missing. According to this view variability with age in ability to construct different kinds of drawings may be partially the result of the availability of learning experiences for the acquisition of both representational concepts and production rules. A more complete representational system with appropriate production rules would enable children to generalize to a broader range of figures, unlike the earlier less adequate system which worked for some figures but

not for others.

This proposal presents the child as actively engaged in hypothetical reorganization of the construction process. Three points about the specific nature of these cognitive processes can be made.

First, following Arnheim (1974), both representational systems and production rules are seen as influenced by the limitations and possibilities of a particular medium choice. The concepts and rules for production of oil painting, water color, and sculpture are likely to vary extensively. Fortunately, standard representational systems exist for realistic drawing such as a variety of perspective systems. Perspective systems offer sets of concepts and production rules for drawing spatial relations. Since children express a preference for realistic drawing, a measure specifically assessing children's ability to use a perspective system can be considered a plausible means of evaluating children's ability to draw spatial relations.

Second, Piaget and Inhelder have proposed that the cognitive immaturity of young children restricts their drawing ability because of their incomplete understanding of three-dimensional space. In order to test their hypothesis that knowledge of three-dimensional spatial concepts is primarily responsible for young children's drawing characteristics, a measure can be created to test children's ability to construct the specific spatial relations they propose children lack: orientation of verticality, before and behind relations, and a coherent point-of-view. Performance on this independent

measure of three-dimensional spatial knowledge compared to the above measure of two-dimensional spatial knowledge allows us to test the hypothesis that knowledge of the specific three-dimensional spatial concepts tested is primarily sufficient to account for the drawing characteristics of young children or if additional two-dimensional representational systems are required to account for the drawing characteristics of young children.

Conceptual theorists have argued generally that children's drawing ability is restricted by their stage of cognitive development. While cognitive immaturity undoubtedly underlies some of the difficulties young children have in constructing realistic drawings, the extent to which drawing concepts can be affected by learning experiences regardless of level of cognitive development is unknown. If Arnheim is correct about the role of two-dimensional representational knowledge in children's drawing, then a test of the degree to which two-dimensional representational training improves drawing ability should give further definition to the developmental course of drawing ability.

Finally, it is apparent from the literature review that psychologists have generated few sustained inquiries into the cognitive nature of children's drawing ability. A few psychologists (Arnheim, 1954; Goodnow, 1977) have regarded drawing activity as a topic worthy of study in its own right, but it is most characteristically studied as supplemental evidence for theories arising in other research areas (Harris, 1963; Piaget & Inhelder, 1956). The result has been a somewhat

sparse body of background descriptive information about what children typically think about when drawing. In this formative period of research, it is easy to miss some of the significant information children themselves can provide about the cognitive qualities of drawing activity. A more balanced account of the role of cognitive processes in drawing can be obtained by interviewing children about their spontaneous conceptualization of drawing during the drawing process. Cognitive scientists have presented a model of naturally occurring cognitive processes which can be applied to the development of children's drawing ability. In particular, evidence for the formation of drawing scripts may reveal some of the qualities and structure of cognition in drawing that have been missing from theories of drawing development.

The following section outlines a design for testing the hypotheses presented in this model:

1. Drawing ability, as measured by a test of ability to draw in perspective, will not be highly related to understanding of three-dimensional spatial concepts, as measured by a test of ability to construct three-dimensional spatial relations.

   Alternatively, no differential performance is hypothesized between age levels on the three-dimensional spatial concepts test. That is, no significant differences are expected between older and younger children's performance on this test. However, differential performance is expected between the two age levels tested on the drawing test; older children are expected to be better drawers than younger children.

2. Drawing training using representational models will significantly improve drawing productions at the two age levels tested as compared to simple practice.

> Also, differential performance is expected between ability to construct the two drawing types--human figures performing activities and landscapes.

In addition to the experimental study of these hypotheses, an exploration of the spontaneous cognitive processes which contribute to children's drawing ability will be conducted without predetermining hypotheses to be tested. This approach is expected to enhance the potential of the interviews for broadening understanding of the nature of cognitive processes involved in the development of drawing ability.

Chapter II

DESIGN AND METHODS

This chapter will first present the rationale for the study design, and then the methods for administering and scoring the experimental procedures. A rationale and description will follow of the method for conducting the inquiry into children's reports of cognitive processes involved in drawing ability.

Experimental Design

In order to test the hypothesis that drawing ability is not highly related to understanding of three-dimensional spatial concepts, each child was administered two tests. The first test was a measure of children's ability to construct three-dimensional spatial concepts; the second was a measure of their ability to draw standard linear perspective. Two age groups of children, 6 and 9 year olds, were included in the sample to test the alternative hypotheses of no age differences on the measure of three-dimensional spatial construction and superior performance of older as compared to younger children on the test of drawing ability.

To test the hypothesis that drawing training using representational models will improve children's ability to draw in

perspective as compared with simple practice, one of two kinds of training procedures was administered to each child. The success of the training procedures was measured by obtaining baseline measures of drawing ability prior to training and post-test measures of drawing ability after the training was completed. The same two age groups were included in this part of the study in order to test whether both older and younger children will improve their drawing ability following training using representational models.

Subjects

Children of two ages were chosen to correspond to the two levels of developmental maturity Piaget and Inhelder predicted would be found in understanding spatial concepts. Six-year-olds were thought to be too young to take into account perspectives other than their own egocentric view, and too young to understand either orientation of the vertical or before and behind relationships. Nine-year-olds were believed to be mature enough to have a significantly better understanding of these spatial concepts. Consequently, 36 children were selected in each of the above age groups (N = 72).

No *a priori* assumptions were made about differences between races and sexes on the experimental measures of the study. Since little is known about realistic drawing of human figures and landscapes, and since it is considered important to the purpose of the study to ascertain children's typical drawing ability, both sexes and both predominate races in the

school system were included in the study. Of the 72 children in the study, 18 of the younger children and 19 of the older children were girls. Seventeen of the children in each age group were black and remaining children were white.

The school chosen for child selection was of average intellectual ability (IQ of approximately 100). As indicated earlier, the positive relation between IQ and drawing ability makes it necessary to select a sample with an average IQ in order to approximate typical levels of drawing ability for the age groups studied and to ensure that the information gained from the study would be pertinent to the performance of typical school children. Participating children came from predominantly low-income homes in which the parent(s) were characteristically semi-skilled workers.

Of those children for whom permission was requested, only two children were not included in the study; one parent refused permission and one child was dropped from the sample because she did not belong to either of the two major racial groups.

The experimental procedures presented below were administered separately by two experimenters; each experimenter tested children at both age levels and conducted both kinds of training procedures. The author, who is experienced in testing children at this age, conducted all procedures for approximately 1/3 of the children in the sample. Procedures were administered to the remaining 2/3 of the sample by a research assistant unfamiliar with the hypotheses of the study. The assistant received preliminary instruction for

administering the procedures including practice with a subject not included in the study. Supervision was available to the research assistant upon request throughout the study.

Procedure

All test and training procedures were individually administered. First, all children were initially tested for knowledge of three-dimensional spatial concepts. Then children in each age group were divided into race-and-sex subgroups. Children in each of these subgroups, white males, black males, white females and black females were randomly assigned to one of two training conditions: representational training (condition A), or drawing practice (condition B). Where scheduling permitted, training occurred in two sessions on consecutive schooldays. The drawing post-tests were administered on the third consecutive school day. This scheduling was possible in the majority of cases. Children were trained to produce drawings of two types known to be popular choices with them at this age--humans performing activities and landscapes. To help determine the effects of training procedures, novel figures of each drawing type were introduced in the post-tests. A description of the three-dimensional spatial concepts test, and the two-dimensional spatial drawing test and training methods follow.

Measures of Three- and Two-dimensional Spatial Concepts

The first test administered was a measure of children's knowledge of three-dimensional spatial concepts consisting of three subparts: orientation of the vertical, before and behind spatial relations, and children's ability to adopt a point-of-view. Overall performance on these measures indicated knowledge of the three-dimensional spatial relations Piaget and Inhelder hypothesized developed during the stage of intellectual realism and which they believe primarily account for the characteristics of children's drawing in this age range. The second measure obtained during initial testing was a measure of children's ability to draw spatial relations realistically using standard linear perspective. This measure served two purposes. It represented a means of comparing children's knowledge of a two-dimensional representational system to their knowledge of three-dimensional spatial concepts. It was also used as a baseline measure preceding training procedures to allow a pre- and post-test comparison of the effectiveness of training procedures.

Training Using Representational Models and Drawing Practice

One of two training procedures was administered to the children. Training condition A is the following procedure: first, children were asked to copy one of a series of 4 spatially complex, two-dimensional drawing models (2 models

of each theme). (See Figures 1 - 4) Then they were required to produce a drawing of the same subject from memory. According to the proposed model of cognitive development in graphic production, requiring children to copy actual solutions to a drawing task could improve drawing ability because it directs their attention to the precise areas in drawings which are difficult to produce and provides examples of two-dimensional solutions exemplifying representational concepts. By requiring children to make a series of drawings on the same theme, the particular pose or composition of a single drawing can be deemphasized, thereby encouraging children to develop representational concepts and production rules which apply to more than one figure.

Training condition B functions as a control condition; children practiced drawing from their imaginations the same subject themes as in condition A. Practice without two-dimensional models serves as a particularly useful comparison to the other training condition because it is likely to be the most common drawing activity that children engage in.

Two subject themes were chosen for the training procedures--human beings performing activities and landscapes. These themes are children's most popular choices as subjects in many cultures (Kellogg, 1970). By choosing popular drawing subjects, the cognitive processes naturally involved in children's drawing ability are more likely to be engaged during experimentation. The variety of pictures that constitutes these themes also allows the experimenter to ask for relatively uncommon drawings of familiar subjects. For this experiment,

standard Western perspective will be used to establish criteria measures. Previous studies have indicated that children choose pictures accurately drawn in this style in preference to their own drawings (Maccoby & Bee, 1965).

Drawing post-tests included production from memory of both a familiar and novel drawing for each subject theme--human beings performing activities and landscapes. Ability to depict the novel figure provided a measure of children's ability to generalize from the drawing training.

Experimental Methods

The Three-dimensional Spatial Concepts Test

The apparatus for the three-dimensional spatial concepts test consisted of two kinds of display scenes: a "hill" covered with green clay (Duncan Weirddoh) upon which toy dolls, trees, and telephone poles were stuck, and a green gameboard "field" upon which dolls were maneuvered. The child was given a doll to examine and the "hill" scene was explained. The experimenter demonstrated the flexibility of the doll's joints and encouraged the child to converse about the doll and the scene. Children were tested on their ability to correctly orient the vertical parts of a composition by asking them to place sets of dolls, trees, and telephone poles in an upright position on the hill.

> Items #1-3: "I want you to place your (doll, tree, pole) on the side of the hill so that it is standing straight up."

Spatial concepts of before and behind relationships were tested using the dolls on the green gameboard field. The experimenter placed the appropriate dolls on the field facing the child with the following instructions:

> Item #4: "I'm going to stand the man in the red shirt on the grass. (second doll introduced) Here is a man with yellow clothes and a helmet. Stand this man behind the man in the red shirt, so that he is facing you, too."

> Item #5: (third doll introduced) "Stand this woman in front of the man in the red shirt, so that she is facing you, too."

> Item #6: "Who is standing in front of the man with the helmet: Who is standing behind the woman with the yellow clothes?"

The third set of items tested the children's ability to distinguish a single point-of-view or perspective. For this set of items the experimenter shifted her seating position from immediately next to the child to an adjacent side of the table. Appropriate dolls were handed the subject in turn with the following six requests:

> Item #7: "Place the woman on a corner of the grass that is furthest away from you."

> Item #8: "Now I want you to place this man on a corner of the grass that is far away from the woman in the yellow clothes."

> Item #9: "This time I want you to place the man in the red shirt on a corner of the grass that is far away from me."

> Item #10: "Now I'm going to ask you to do something that is a little harder. I want you to place this boy so he is far away from the woman in the yellow clothes but close to you."

> Item #11: "This time I want you to place this person far away from you but close to me."

Item #12: "This is the last one. I want you to place the doll on the grass so that she is facing me and you can see her back."

The Spatial Drawing Test

For training in the spatial drawing test, children were given a #2 pencil with eraser and an 8½ by 11 inch sheet of white paper.

Pre-test drawing ability was assessed by asking all children to produce sample freehand drawings of a person running and a house with a tree (examples of the two types of drawings under investigation). Post-test 1 called for familiar drawing subjects, the running person and a house with a tree again, and post-test 2 required novel drawings, a person jumping rope and a garden with a fence "all the way around it."

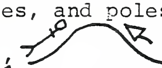
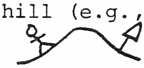
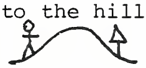
For representational training, condition A, the children were asked to: 1) compare their pre-test drawing to a drawing model; 2) copy the model; and 3) make the best drawing they could using what they had learned from all the pictures but without looking at them.

Drawing practice training, condition B, required the children to draw the same type of picture at least three times from memory. The child was asked, "Let's see how many different kinds of (runners, houses with trees, people jumping rope, or gardens with fences) you can draw." Care was taken not to suggest ideas to the child, but ideas offered by the

children were encouraged.

Scoring the Three-dimensional Spatial Concepts Test

A perfect score for the three-dimensional spatial concepts test was 36 points. Credit was divided evenly between the three spatial relationships under investigation; 12 points each for correct orientation of verticality, before and behind relationships, and single point-of-view.

Vertical placement of the dolls, trees, and poles was coded as either parallel to the hill (e.g., ), perpendicular to the hill (e.g., ), vertically correct (e.g., ), any other incorrect angle, or refusal to place the object. To qualify as upright, the perpendicular axis of each object had to be within 10 degrees of the vertical in any direction. This set of items was then scored in a somewhat complex manner: totally correct placement was given complete credit, consistent placement of any other kind received no credit, and a mixture of correct and other kinds of placement was given partial credit. Partial credit was assigned according to the following criteria.

<u>Dolls and trees</u>:

only 1 object correct = 1 point
2 objects correct = 2 points
4 objects correct = 4 points

<u>Telephone poles</u>:

zero or only 1 object correct = 0 points
2 objects correct = 1 point
3 objects correct = 2 points
4 objects correct = 4 points

Differences in scoring reflect the fact that one telephone pole was frequently placed on top of the hill, a position which is ambiguous with respect to the categories of placement.

Accurate placement of the dolls in before/behind relationships was considered correct if dolls were placed appropriately and directly along the child's own line of sight (3 points each). Responses were also considered correct but less precise if the dolls were placed appropriately, but also to the left or right of the child's line of sight (1 point each). Placements were counted as incorrect if they were made in the reverse orientation to that requested, or if they were made to the side of the reference doll (0 points). For the final item, correct indication (verbal description or pointing) of the dolls located in front of or behind the reference doll received 3 points for each relationship. No credit was given for inappropriate indications, or when initial improper placement prohibited the correct response.

Accurate placement of the dolls from a single point-of-view was considered correct for the first three items if the child placed the doll in either of the appropriate corners (2 points for each item). For the last three items both criteria had to be met for credit to be given--the child must have correctly taken into account both his or her own, and the experimenter's line of sight (2 points for each item).

Scoring the Spatial Drawing Test

A scale was devised to measure the accuracy with which the children drew spatial relations in perspective. Ratings were based on the degree that drawings depicted correct orientation of the parts to another part, orientation of the parts to the whole, and occlusion. For purposes of comparison, these characteristics parallel but are not identical to the three-dimensional spatial concepts discussed above. A total of 36 points was possible--0-12 points for each of the three perspective characteristics.

Since these three characteristics are depicted in different ways in different types of pictures, separate scoring criteria were needed for each type of drawing made in the pre- and post-tests. Consequently, scoring criteria measuring the characteristics outlined above were developed for four pictures; a running person, a house with a tree, a person jumping rope, and a garden with a fence (see Appendices A, B, C, D & Figures 5-8).

For scoring purposes, the drawings were anonymous and randomly ordered. Two independent judges scoring a subset of pre-test and post-test 1 drawings (70 out of 288) achieved 85% interjudge agreement: agreement constituted consensus on both the item scored and the number of points accredited. In the same manner 82.5% agreement was obtained on a subset of post-test 2 drawings (50 out of 144).

Cognitive Processes Experienced in Drawing

Relatively little is known about the cognitive processes implicated in the development of children's drawing ability. One means of expanding this area of knowledge is to regard children as valid informants about their own intellectual development. This methodological approach has proven useful to psychologists, notably Piagetians, and is frequently the method of choice among cognitive scientists interested in spontaneously occurring cognitive processes. The use of children as informants about their own drawing processes can provide insight into those natural cognitive processes which contribute to children's graphic production. Based upon the model for scripts proposed by cognitive scientists, it would seem reasonable to suppose that children develop drawing scripts. Drawing scripts may provide a means for interpreting new information about spontaneous drawing content and the cognitive processes and structure realistic drawing requires.

Procedure

The first interview was conducted immediately following the post-tests for training. Children were shown the familiar drawing they had just completed and asked to explain how they made their pictures (a person running and a house with a tree in front of it). All of the first interviews were conducted in conjunction with final training procedures and all training post-tests were completed before any

children were interviewed for the second interview. As a consequence, a lag of approximately 2 weeks occurred before the second interview was begun. All second interviews were completed in approximately 1½ school weeks.

The 17 children participating in the second interview were instructed to do the following: 1) to explain to an interviewer how they would make a picture of a person digging in a garden (a novel subject likely to involve the representation of spatial relations); 2) to describe what they were doing while they were making a picture of the person digging in a garden; and 3) to describe what they were doing while making a picture of their own choosing. The emphasis on report during the drawing process was expected to elicit more accurate reports of processes directly involved in drawing instead of _post hoc_ constructions of drawing activity. The interviewer was directed to encourage explicit accounts of their thinking during the drawing task, and children varied in their ability to do this. Some children required prompting, others alternated drawing with description and explanation, and still others were able to draw and converse simultaneously. Individual interviews lasted from 20 minutes to 2 hours and were tape recorded. Accompanying pictures were collected and identified.

Subjects

A subset of children used in the previous portions of the study was selected to participate in two kinds of interviews about their drawing. First, a representative subset of 12

children was randomly selected from the original study sample, retaining the balance of age, sex, and racial characteristics. Since the data consist of verbal reports, younger children, boys, and minority groups may have a tendeny to report less of what they know, especially to a white, female interviewer. Younger children might also be expected to report qualitatively different ways of reasoning about drawing processes. Evidence of age differences is reported in the content analysis. In addition, an equal number of children from both training conditions were included to prevent over representation of children with practice using models.

The original intention was to use this same subset of children for the second kind of interview. Unfortunately, a malfunction in the tape recorder resulted in the loss of 6 of the 12 first interviews. Consequently, an additional 11 children who had not participated in the original interview were included in the second one, bringing the total sample for the second interview to 17 children. Again, the age, sex, and racial characteristics of the original sample were retained, as well as equal membership in both training conditions.

Chapter III

RESULTS

The first two sections of this chapter present the results of the data analysis for the two principal hypotheses and their corollaries. The first section examines the distribution of the scores on the measures of three-dimensional spatial concepts and drawing ability and presents the results of a Chi-square analysis of their relationship. This is a test of the hypothesis that children's knowledge of three-dimensional spatial concepts is highly related to their level of drawing ability. Two *t* tests assess the alternative hypotheses that no age differences occur between children on the measure of three-dimensional spatial concepts, and that older children draw better than younger children. The second section presents the results of a mixed model analysis of variance employed to test the hypothesis that children will improve drawing ability for familiar and novel figures following training using representational models as compared to practice. Again, older children were expected to draw better than younger children. In addition, it was hypothesized that the degree of difficulty will differ for producing the 2 drawing types--human figures and landscapes. The third section presents a content analysis of the interviews conducted with children about the drawing process.

Performance on Tests for Constructing Three- and Two-dimensional Spatial Relationships

Children at both age levels demonstrated a superior ability to perform the tasks required by the three-dimensional spatial test. The mean scores for 6 and 9 year olds were 28.97 and 34.8, respectively, while the median scores were 28.5 and 35.9, respectively, out of a possible 36 points. In the younger age group where performance was expected to be poor, 9 out of the 36 children received a perfect score. In addition, the distribution was negatively skewed; 26 younger children scored in the top third of the range, 9 in the middle third, and only one child in the lower third, while 35 older children scored in the top third of the range, only 1 in the middle third, and none in the lower third. The performance of the younger children was not significantly different from that of the older children (t = .68).

In contrast, children in both age groups performed quite poorly on the spatial drawing test. Six year olds had a mean score of 5.1 and a median score of 4.5; and 9 year olds had a mean score of 8.07, but a median score of 5.8, out of a possible 36 points on a baseline measure of spatial drawing ability. The distribution of these scores was also skewed, but in the opposite direction. Thirty-four of the younger children scored in the bottom range of the distribution and the remaining 2 scores were in the middle range. Thirty-one of the older children were in the lower third of the distribution, 4 in the middle third of the range, and only 1 in the top third.

The difference between age groups was significant ($t = 3.06$, $p < .005$) indicating that older children drew better than younger children.

A Chi-square analysis of the relationship between the measure of three-dimensional spatial concepts and the measure of spatial drawing ability did not indicate a significant association ($\chi^2 = 3.13$, n.s.). (See Table 1) As expected the lack of association could be attributed to the large number of children who performed well on the three-dimensional spatial concepts test but who performed poorly on the spatial drawing test.

In summary, Piaget and Inhelder's hypothesis of a developmental difference in ability to comprehend three-dimensional spatial relationships is not supported by the superior performance of children at both ages on the three-dimensional spatial concepts test. The especially strong performance of 6 year olds on this test indicates that younger children are already proficient, at least by the present measures of three-dimensional spatial knowledge. The degree to which realistic drawing of human figures and landscapes is difficult at both ages is surprising and will be discussed in the final chapter. Nonetheless, older children are better drawers than younger children. This discrepancy between demonstrated understanding of three-dimensional relations and spatial drawing at both ages supports the present hypothesis that an additional kind of knowledge is required to explain the drawing characteristics of children at these ages.

The Effect of Training Upon Drawing Perspective

Drawing Familiar Pictures

In order to assess the effect of drawing training using representational models for familiar pictures, a mixed model analysis of variance (ANOVA) was conducted. The analysis was carried out within 2 X 2 X 2 X 2 ANOVA with variables divided into the following categories: 1) age--6 and 9 years old; 2) training condition--drawing concepts (A) and drawing practice (B); 3) time tested--pre-test and post-test 1; and 4) drawing type--human figures and landscapes. Age and training conditions were the two between-subjects variables, and time-tested and drawing type were treated as the two within-subjects variables. An acceptable significance level of 0.05 was set.

As predicted, the results of this analysis revealed that training A produced better drawing performance than training B ($F\ (1,68) = 6.07$, $p < .025$), and that children had better drawing ability at post- than at pre-training testing ($F\ (1,68) = 5.90$, $p < .025$). (See Table 2) Most importantly, the analysis revealed a training condition by time-tested interaction ($F\ (1,68) = 26.62$, $p < .001$) indicating that training A using representation models had benefited children's drawing performance at post-training testing, while simple drawing practice did not. (See Figure 9)

A main effect for age was also found ($F\ (1,68) = 14.63$, $p < .001$) confirming that overall older children drew better than younger children as the earlier t test had indicated. This was reflected to some degree in a 3-way interaction (age

X training conditions X time tested) which indicated that the success of training A on post-test measures was more pronounced for older children (F (1,68) = 5.51, $p < .025$). (See Figure 10)

Unexpectedly, a 2-way interaction was found for age and drawing type (F (1,68) = 18.30, $p < .001$). (See Figure 11) Older children found human figures easier to draw, while younger children found human figures more difficult to draw.

Drawing Novel Pictures

A mixed model ANOVA was conducted to assess the effect of drawing training upon novel pictures. This is a test of children's ability to generalize from their training with familiar figures. The 4-way design of the analysis was the same as that used above; variables were the same as well except that the time-tested variable compared pre-tests and post-test 2 results.

The results of the analysis did not show main effects for either training condition ($F < 1.$) or time-tested ($F < 1.$). (See Table 2) Neither training condition was more beneficial than the other, and drawing performance was unchanged following training. Consistent with these findings, the analysis showed no training condition and time-tested interaction ($F < 1.$), indicating that training A had no measurable benefit to children drawing novel pictures. (See Figure 12) A 3-way, training condition, by time-tested, by drawing type, interaction was found (F (1,68) = 6.17, $p < .025$). (See Figure 13) Since no main effects were found for either training condition

or time-tested, and since interaction effects were not predicted for drawing types, this interaction is not interpretable and will not be discussed further.

Again, the analysis revealed a main effect for age ($F\ (1,68) = 23.86$, $p < .001$) confirming that older children are better at drawing novel pictures as well as familiar pictures.

As predicted, a strong main effect for drawing type was found ($F\ (1,68) = 39.17$, $p < .001$) showing that human figures were easier to draw than landscapes. Unexpectedly, an interaction for age and drawing type was found that is consistent with these main effects ($F\ (1,68) = 6.47$, $p < .025$) showing that the difference in difficulty found for the two drawing types was more pronounced for older children. (See Figure 14)

Finally, given the lack of main effect for time-tested, a less important significant interaction of time-tested and drawing type was found ($F\ (1,68) = 58.94$, $p < .001$). (See Figure 15) This result may indicate that ability to draw novel figures differs from ability to draw familiar figures following training, but most likely indicates that post-test examples of figure types were more difficult to draw than pre-test examples.

A Summary of Training Effects on Drawing Ability

Older children were found to produce better drawings than younger children on all measures of drawing ability. (See Table 3) Older children's greater drawing skill was

demonstrated on the baseline measure, and following training on both familiar and novel drawing figures.

Most importantly, the drawing concepts training using representational models improved drawing ability for familiar figures at both ages as predicted. However, there is no evidence that training of either kind generalized to novel figures as children drew no better or worse on the novel figures than on the figures used as baseline measures before drawing training.

The analyses conducted to assess the relative difficulty of the two drawing types reveal a complicated and less interpretable pattern of results. Most of the time the human figures used as examples were easier to draw than the examples of landscape figures. This was true for both age groups drawing novel figures, and also true for older children drawing familiar figures. Younger children drawing familiar figures were an exception to this generalization; the results indicate that younger children found familiar human examples more difficult to draw than landscape examples. Unfortunately, a methodological flaw in the experimental design further complicates interpretation by confounding the relative difficulty of novel figures within and between drawing types. The original design should have been balanced so that half the children in each training condition at each age level were given the reverse order of particular examples of types of drawings. As a consequence of this design ambiguity, it is possible that the differences observed on novel figures between drawing types may result from the particular post-test examples being easier

and harder to draw than the corresponding pre-test examples. In this case, people jumping rope may be easier to draw than people running, and gardens with fences may be more difficult landscapes to draw than houses with trees. In short, it is difficult to make an unequivocal interpretation of the results pertaining to drawing type.

In summary, these results indicate that training using representational models is effective in improving children's drawing ability at both 6 and 9 years old. However, in this form, the usefulness of the training is limited to figures that have been studied during the training procedures. The next portion of this chapter will present a content analysis of interviews conducted with some of these children about their drawing. Included in this section will be more information about children's representational concepts and production strategies.

Naturally Occurring Cognitive Processes Involved in Children's Drawing

As indicated earlier (p. 31), the relative lack of knowledge about the conceptual nature of the development of children's drawing activity suggests that researchers would benefit from using children as informants about their own drawing processes. Within the discipline of child development and particularly in the area of cognitive development, researchers have found that children's verbal reports provide insight into the spontaneous cognitive processes which

contribute to development (e.g., Piaget, 1954; Brown, 1973). Consequently, interviews were conducted with children about the drawing process to allow the investigator to explore the spontaneous content and organization of drawing ability. This portion of the chapter presents a content analysis of the information collected from children about three characteristics of their drawing activity: 1) selection of the elements, 2) generation of familiar associations, and 3) use of specific production strategies. Examples children reported of these characteristics are included in the Appendices.

The Choice of Elements

While the elements of a picture vary depending on the subject matter, sufficient consistency of choice was found across children and age groups to show agreement about what is required to complete a given drawing. In this case the drawing was a picture of a person digging in a garden. The following list of examples illustrates the consensus.[1,2] (See Appendix E)

#58 - YWF

I. Where would you start?
C. Digging.
I. What would you draw first?
C. The people.
I. The person who was going to be digging? Ok, and what part of the person would you draw first?
C. The head.
I. Um-hm.
C. And the hair, and legs, then the arms, then the clothes, and then I'd start on the dirt.

#41 - YWF

C. Well, you start with the head and get down to the feet and then you make the dirt and then you make the shovel and then make a hole.
I. What else would you do?
C. Make the face and the clothes.
I. Would you do that last? After you've made the dirt and the hole? Ok, would you put anything in your garden?
C. You can put some carrots and lettuce and apples.

#52 - OWF

C. I'd make the person standing on some dirt and a shovel in his hand.
I. Ok, well how would you start? What would you make first?
C. Probably the ground.
I. You'd draw the ground first? And then what would you do?
C. I'd draw-----his hands and then the shovel-----

#29 - OWF

C. First I would make the garden and then I'd try to make him look like standing up, and then I'd kinda like make the shovel go down digging and then I'd make half the garden like I'd already dug it and plant seeds.

I. What was planted there?
C. Tomatoes, and cucumbers, onions and corn and beans.

Nelson (1980, p. 8) and Schank and Abelson (1977, pp. 41 & 45) claim two things about the elements of a script. First of all they claim that some elements are chosen as obligatory components and represent a shared understanding of that kind of event. In children's reports this was demonstrated by a consensus for including a set of components in the drawing of a person digging a garden. In the interview segments in Appendix E the group of 17 informants expressed agreement about the inclusion of the following items: a person or kind of person (e.g., man or mama) (16); dirt or ground

(15); a shovel (13); the digging or shoveling activity (11); legs (10); a body (8); seeds (7); tomatoes (7). There are also many elements that are less frequently mentioned (e.g., hat, clouds, the sun, a dot), but these elements have an ambiguous status since children do not verbalize all that they include in their drawings.

Some elements are considered to be optional as shown by their interchangeable use with other elements. Two kinds of examples were reported by the children. In the garden digging task the optional variable consisted of the alternative choices children reported in the kinds of plants and seeds depicted (e.g., carrots, beans, tomatoes, et cetera). In the second example of optional variables, children reported two items, kinds of plants and seeds, as mutually exclusive variables. Of the 14 children reporting this kind of variable, 8 reported only kinds of plants, and 6 reported only seeds, while only 3 children described simultaneously including kinds of plants and seeds in their drawings. Children's mutually exclusive use of these two elements reveals their understanding of the temporal logic that plants grow from seeds.

The Function of Familiar Associations

In discussions of all types of pictures, children related their own familiar and "real" associations to the drawing content. The experiential quality of these associations is supported by their common occurrence (e.g., "Dad, my friend,

my neighbor's house or garden") and by the plausibility of the reported activities (e.g., "we jump rope at recess"). This quality of drawing processes would seem to reflect children's interest in familiar people, activities and objects. On this basis drawings are representations of the conceptual content and organization of the typical child. The experiential quality of these associations indicates they may be regarded as diary-like chronicles of children's every day world. This view of drawings as chronicles suggests that children construct drawing scripts based upon their every day experience.

Children reported two kinds of associations in their interviews--simple and elaborated ones. The simple association is most commonly reported and serves to identify the subject depicted. When asked what they were thinking about while drawing a person or house children would reply, for example, "my Mama" or "my neighbor's house." (See Appendix F) The more elaborate associations give a detailed account of the experience represented by the drawing, often describing a sequence of actions, dialogue, and feeling not completely depicted in the drawing. (See Appendix G) The following are examples.

#49 - YBF

C. First, she was diggin' in the ground, then she went back in the house, then she stayed in the house, and then she came back out with the flower seeds and started putting them in the ground.

#29 - OWF

I. Now how did you know how to do that?
C. Well, I go down to my grandfather's house, I go down there a lot-----and I went up there and watched him cause I didn't have nothin else to do except play with-----. He's got a big ole-----.

Some of these elaborated associations contain discussions of possible clinical significance which are beyond the scope of this investigation.

Children's use of associations is consistent with cognitive scientists claims about scripts in two more ways. First of all, elaborated associations usually involve a time-ordered sequence of events (e.g., as indicated above, first you dig in the ground, then you get the seeds and finally, you put the seeds in the ground). In addition, the knowledge involved in an association is more often episodic knowledge and therefore includes much of what is characteristic of an event instead of including only what defines an event. Constructing the association goes beyond a summary definition to a description that evokes the experience; a sequence of time-ordered events is presented, elements are more concrete and described with more detail, and the location of people, activities, and objects plays a significant role. The episodic knowledge reported in elaborated associations suggests that children may be relying upon mnemonic memory processes to retain information about elements, location, position and shape and use this information in drawing production.

Production Concepts and Strategies

A basic component of children's understanding of graphic production is the general concept characterized by Arnheim as the translation of objects from the three dimensions they occupy in space into the two dimensions required by the flat page (see discussion, pp. 4 - 5). Following Arnheim, younger children lack an adequate representational system for converting such spatial relations as before and behind relationships into linear perspective principles such as occlusion. Analysis of the interviews indicates that 9-year-olds have a better understanding than do 6-year-olds of these kinds of translations. In the first place, younger children more frequently do not make the distinction between the actual person or activity and a picture of these things. As a result, for the younger child the act of drawing becomes an act of participating in the depicted scene. This lack of distinction between the real event and the symbolized event occurs in reports of 4 out of the 9 younger children, but none of the 8 older children expressed this idea. (See Appendix H)

#32 - YWF

I. And how would you make it look like she was digging?
C. All I could do was make her just like she's bending over and she's puttin' some seeds inside of it.
I. And what else would you do?
C. I would first dig the holes and then I'd put the seeds inside.
I. You'd do what to the holes?
C. First I'd dig the holes.
I. Ok, first you'd dig the holes.

C. Then I'd put the seeds inside. Then I'd keep on watering them when it's sunny and hot and when it rains I don't need to water them.

Furthermore, older children more frequently express the idea that objects can have geometric equivalents on the drawing page (e.g., the torso on the human figure can be represented by a rectangle). This kind of report was given by only 2 out of the 9 younger children but by 6 out of the 8 older children. (See Appendix I)

#48 - OWF

C. I started with the legs-----two straight lines and then I took a curve.
I. A curved rectangle to the body?
C. And I kinda put a hole on it so I could put the head to the neck-----and then the eyes, nose, and the mouth. A dot for the eyes and a dot for the nose and the mouth-----and then I put another one like it's behind him, then I drew a-----for the shovel then I drew kinda like a circle and then I started drawing regular lines for the dirt and a big pile of dirt and a hole. And then I made shoes.

Briefly then, 6 year olds frequently fail to comprehend that drawings are symbols, while 9 year olds already know that a particular kind of symbol--a geometric figure--can be used when drawing to represent people and objects in real life.

Children's acquisition of the concept that drawings are symbols, and their knowledge of what kinds of symbols are successful in graphic representation may be influenced by instructors. References to instructors are common at both ages; five children in each age group made repeated reference to the advice of various kinds of instructors. Instructors themselves, were of all ages, ranging from, "my friend, cousin, sister or brother," to "my Dad, Mom, and art teacher."

Younger children tend to just refer to the instructor and say they observed them drawing. Older children more frequently report examples given by instructors for geometric symbols (e.g., "you make an 'n' then you circle the two lines together to make a heart"  : ). It would be impossible to tell from this data whether the nature of the instruction or the ability of the child to understand instruction varies with age. However, since the results from the measure of drawing ability indicate that neither children in the older and younger age groups are particularly good at representing three-dimensional space on the picture page, it is also possible that the instruction provided is inadequate or inappropriate for the drawing tasks. While children wish to draw realistic pictures which in our culture requires some knowledge of linear perspective, most adults probably do not know much about drawing perspective. Furthermore, children may be too immature to really comprehend some of the linear perspective principles. Without drawing principles children and adults may continue to develop recipes for individual pictures which are difficult to generalize to other figures. More appropriate instruction might experiment with explicit techniques for representing a simpler principle of perspective such as occlusion. In this case, instruction would include the idea that lines represent edges, and that where part of an object is represented behind another, the far away object has its edge "hidden" by the closer object. This explanation would have to be demonstrated on paper with a sequential

technique for producing the desired effect. Drawing both objects and then erasing the "hidden" parts is a good easy technique. As seen below, older children have invented this solution.

The most salient specialized cognitive phenomenon reported by children are conceptual components and strategies for a linear perspective drawing system. Linear perspective in its most developed form is a complex conceptual system for drawing three-dimensional space on a two-dimensional page. In a simplified form, it is based upon principles for depicting continuity in space (which includes occlusion concepts and strategies) as seen from a point-of-view or perspective, and utilizes at least one vanishing point. The vanishing point is an imagined point located on or off the drawing page towards which lines constructed of parallel points in space converge. In one-point perspective, the viewer is assumed to be standing in a plane parallel to the page and all space is conceived of as receding from that plane toward the vanishing point. Thus, the front of a house can be assumed to be parallel to the viewer's plane () and the side converges toward the vanishing point since the side is located in a continuously receding space (). With two vanishing points, an edge of the house front is conceived of as parallel to the viewer (|) and the front and side recede in continuous space by converging toward separate vanishing points (). The following sections present evidence about concept and strategies children reported for producing

occlusion, convergence and a point-of-view.

Occlusion. Included within the linear perspective system are two related kinds of occlusion concepts. The first explains how from any single point-of-view separate objects may be located in front of others. To depict this relationship using linear perspective, the nearer object will "hide" at least part of the further object. In two-dimensional picture space this means that the shape of the nearer object will interrupt or occlude the shape of the object depicted as further away. The second kind of occlusion is a variation on the first, it differs in that the object occludes a part of itself rather than a separate object from a single point of view. This is most commonly observed in drawings of people and complex three-dimensional geometric shapes.

Apparently, children understand occlusion better than the other reported perspective conventions. (See Appendix J) Only 3 instances of erroneous occlusion were reported (2 by younger children and 1 by an older child). They reported that the page should be more three-dimensional; "thicker" or that the back of the page was the proper location for the back of an object. In contrast, 3 older children gave 8 examples of how to accurately depict the simple kind of occlusion.

#12 - OWM

C. I started to put the house behind the tree, but I erased the top of the house and the bottom and put the tree in front. . . .

Two older children also gave examples of the more difficult kind of occlusion.

#52 - OWF

I. All right. Look at the picture of the person jumping rope. How did you draw that picture?
C. Her legs are behind her and this is her knees.
I. Oh, I see. The lower part of her leg you don't see in the picture.
C. No, because she-----her legs are up in the air behind her.

In summary, the evidence suggests that older children have a fair understanding of the drawing conventions for occlusion in some but not all kinds of pictures.

<u>Convergence</u>. Children of both ages frequently reported erroneous descriptions of how to make an object look properly receding in space. (See Appendix K) Typically, children reported that in order for an object to look like it was standing up as it receded, the page itself should stand perpendicular to the drawing surface ().

#29 - OWF

I. Is your fence standing up?
C. Well, not really, but if you stood the picture up you can see it standing up.
I. If you stood the picture up you could see your fence standing up?
C. I think so.
I. You think so.
C. Part of it you can.

Children also remarked that "the page wasn't big enough" or that the sides of the page were the sides of the object. Altogether 2 younger and 5 older children contributed these kinds of erroneous explanations. (See Appendix L)

Only one child, an older one, indicated some understanding of using convergent lines to depict three-dimensional space.

#50 - OWM

I. ...does the fence look like it's standing up?
C. Um-hm.
I. It does. And how did you make it look like it was standing up?
C. Put it with an angle.

Point-of-view or perspective. Comments about a single point-of-view are so rare at either age that knowledge of this concept cannot be analyzed.

Summarizing Children's Reports of Production Concepts and Strategies

Interviews with children about their drawings reveal that 9 year olds generally understand the symbolic nature of drawings while 6 year olds frequently confuse representation with reality. This is demonstrated by older children's reports of using geometric symbols for objects and the contrasting tendency of younger children to discuss drawing as though it were somehow the same as participating in the depicted scene. When specific concepts and strategies for linear perspective are examined, however, older children are not as uniformly knowledgeable about drawing as this suggests. Although linear perspective concepts are the representational concepts most often discussed, older children display good working knowledge of only one kind of concept--occlusion. Younger children tend to regard the two-dimensional page as inadequate for representing occlusion and most often point out that the back or "side" of the page is the proper location for

the back or side of objects. Furthermore, both younger and older children have an inaccurate understanding of how to depict convergence. While responses were mixed to this problem many children indicated that an object would be properly occupying the picture space if the page itself were standing upright so that correct positioning depended on orientation of the object to the viewer, but not upon any notion of objects receding with distance from the viewer. Comments on children's ideas of a point-of-view were too rare to be analyzed.

This chapter has presented the results of the investigation of a group of interrelated hypotheses about the cognitive processes involved in drawing ability. First, the hypothesis was tested that children's knowledge of three-dimensional spatial concepts, as measured by a test of children's ability to construct three-dimensional spatial relations, was highly related to drawing ability, as measured by a test of spatial drawing ability. The alternative hypotheses that knowledge of three-dimensional spatial concepts does not differ at the 6- and 9-year-old age levels, and that older children draw better than younger children were also tested. In addition, the hypothesis that drawing training using representational models improves drawing production as compared to simple practice was examined. Finally, children's reports about the cognitive processes which contribute to the development of their drawing ability were analyzed. The

following chapter will integrate the information from these results and discuss their implication for children's cognitive development.

FOOTNOTES

[1]The interview segments in this paper have not been regularized for grammar, slips of the tongue or hesitation. Names of persons have been replaced by numbers and the age, race, and sex of the child is indicated by either Y or O, W or B and M or F, respectively, and placed above each set of comments by the same child. This information will allow the interested reader to compare comments by older and younger children, as well as by the sex or race of the children.

[2]In Appendix E the elements have been underlines the first time they occur in each child's reports. One exception was made to this guideline: cases in which the experimenter inappropriately prompted the child are not underlined.

Chapter IV

DISCUSSION

The present inquiry has been directed towards elucidating the cognitive processes and structure, and the contents involved in the development of children's drawing ability. Three areas of conceptual relevance were examined: 1) the roles of three-dimensional spatial concepts and two-dimensional representational concepts in drawing spatial relations, 2) the effects of training in the use of two-dimensional representational models upon drawing performance, and 3) reports by children about their own thought processes when drawing. What follows is an evaluation in three parts of the results of these inquiries. The first part discusses the nature of the concepts which contribute to drawing ability. The second part discusses the relevance of drawing concepts acquisition for stage developmental theory. The third part presents an argument that children's construction of scripts in drawing is a significant spontaneous characteristic of their drawing activity.

The Nature of Drawing Concepts

In all measures of drawing ability--baseline measures, and post-training measures of familiar and novel figures--nine-year-old children were found to be better at producing

realistic drawings than six-year-old children. Piaget and Inhelder (1956) have hypothesized that the development of drawing ability primarily results from the development of children's ability to understand three-dimensional spatial concepts. However, even though older children were better at drawing, they were no better than younger children on a measure of three-dimensional spatial concepts, simply because 6-year-olds are already proficient at these tasks. Moreover, no evidence was found to support the hypothesis that knowledge of three-dimensional spatial concepts is highly related to spatial drawing ability. A Chi-square analysis of the relationship between the measure of three-dimensional spatial concepts and the spatial drawing performance was not significant (χ^2 (1) = 3.13, n.s.). The lack of significance in this test could be attributed to the relatively large number of children (34 out of 72) who were highly proficient on the three-dimensional spatial concepts test but scored quite low on the measure of spatial drawing performance. A training study was conducted to assess whether training using representational models would improve children's drawing ability as compared to simple practice. Arnheim (1969, 1974) and Golomb (1972, 1973) have hypothesized that children at these ages lack the pertinent symbolic language to represent spatial relationships in drawings. They emphasize the importance of a translation process whereby a two-dimensional representational system is developed that is capable of conveying three-dimensional spatial information. Standard

linear perspective is such a system. Brief training in the use of representational models drawn according to the principles of linear perspective did produce significant improvement in the drawing performance at both age levels. That is, children improved their ability to draw a figure when training was given explicitly for a particular figure. However, generalizability to novel figures was not demonstrated, and thus no evidence was found to support the hypothesis that the effect of representational training of this kind is stable and enduring. Even though both age groups improved following training, the age of the child did effect the outcome of the training procedure. Drawing improvement was more pronounced for the older than for the younger children.

Finally, interviews with children gave indications of the representational concepts involved in their drawing activity. Older children demonstrated a better understanding of the symbolic nature of drawing than younger children. Nine-year-olds gave more examples of the use of two-dimensional geometric figures such as squares and circles as symbols for three-dimensional objects than did six-year-olds. In addition, younger children frequently failed to distinguish between participating in an activity and symbolizing that activity in a drawing. According to Piaget, the less mature younger child, being egocentric and unable to fully adapt to reality simply regards the symbol as a powerful substitute for the signified. Only at a later stage, around 8 years old, does

play really become make-believe as awareness of the rules of socialization are integrated into the ego (Piaget, 1962). Finally, both younger and older children made attempts to develop specific concepts and production rules for linear perspective, although their knowledge was usually incomplete and often inaccurate. Occlusion is an exception, with older children reporting a fair number of correct concepts and production strategies for this characteristic of perspective. Occlusion may be a less complex concept than other perspective concepts.

Taken together these results indicate that although knowledge of three-dimensional spatial concepts contributes to children's drawing ability, this knowledge is not sufficient to explain the nature of the conceptual link between perception and pictorial representation of spatial relations. Evidence has been presented to show that knowledge of representational concepts, in this case, linear perspective, contributes to the development of children's drawing ability.

J. J. Gibson (1966) has presented a theory of drawing that attempts to explain the nature of this conceptual link between pictures and the real world. Gibson claims that the laws of perspective are determined by optical information and represent a completely non-arbitrary structural equivalence between pictures and the world. According to Gibson, the essential link between the three-dimensional visual world and pictures is established by the information contained in the

light reflected off objects in space and extending to the eye. He hypothesizes that the structure of light can be described by principles of geometrical optics, and that it is these principles which constitute the nature of the translation from three-dimensional objects to two-dimensional picturing (1966, 1971). For example, Gibson argues that different facets of surfaces reflect different amounts and colors of light to the eye so that boundaries can result from changes in intensity between two adjacent facets placed at different angles of inclination. Consequently, drawings representing boundaries can be produced by placing two colors of different intensity adjacent to each other on the page.

Gibson's theory makes strong claims about the non-arbitrary resemblance of representational systems like linear perspective to the visual world. In contrast, Goodman (1968) argues that representation in general and linear perspective in particular are entirely conventional. That is, the resemblance of pictures to the visual world is arbitrarily defined by convention. Hagen (1974) has offered a revision of Gibson's theory of picturing. Hagen argues that picturing involves other more arbitrary modes of resemblance as well as Gibson's non-arbitrary resemblance between the world and its representation. Following Hagen then, a given representational system such as linear perspective may reflect the combination of both non-arbitrary and conventional resemblances to the visual world. On the one hand, knowledge of three-dimensional spatial concepts could be one of many non-arbitrary kinds of

information that is required in the representation of linear perspective.[1] Two more examples of non-arbitrary kinds of information contributing to knowledge of linear perspective would be the principles of geometric optics proposed by Gibson and Gestalt principles of visual organization as proposed by Arnheim (1974). On the other hand, Western representational conventions for depicting spatial relations, such as occlusion, convergence, or point-of-view can represent the involvement of acquired conventions in the development of realistic drawing ability.

Drawing Concept Acquisition and Stage Development Theory

Piaget and Inhelder (1956) have maintained that, in general, a qualitative difference in drawing ability between the two age levels herein studied represents a shift between two stages of cognitive development. As presented by Piaget and Inhelder, stage development theory is not sufficiently explicated to fully account for the development of drawing ability. However, Flavell (1971, 1972, 1981) has raised some important questions about the discontinuity of conceptual processing hypothesized across stages and about the homogeneity of cognitive processing within stages in stage development theory. The evidence resulting from this study may be considered in terms of such questions.

In support of Piaget and Inhelder's principle hypothesis, older children were found to be better drawers than younger

children on all measures of drawing ability during this study. Furthermore, older children benefited more from the training procedure using representational models on familiar figures than did younger children. The consistent superior drawing ability of older children supports the stage development hypotheses that conceptual discontinuity exists between age groups, and that conceptual acquisitions within age groups are relatively homogenous. That is, homogeneous in the sense that children within an age group respond in a similar conceptual manner. A number of researchers (Case, 1978; Chi, 1978; Dempster, 1981; Fischer, 1980; Fischer & Bullock, 1981; Flavell, 1981; Halford & Wilson, 1980; McLaughlin, 1963; Pascal-Leone, 1970; Scardamalia, 1977) have proposed that discontinuity and homogeneity in development may result from age-related limitations on children's information processing capacity.

However, both younger and older children's drawing performance improves with training procedures using two-dimensional representational models. This suggests, as Flavell has proposed, that the concept of stage is less likely to imply discontinuous cognitive development as more explicit knowledge is obtained of the cognitive processes which make up the shift to higher order reasoning (1971). In the training procedure of this study, younger children may have acquired partial knowledge of two-dimensional representational concepts which do not require higher order reasoning. The same procedure may have facilitated older children's

acquisition of representational concepts.

In addition, the lag between acquisition of knowledge of three-dimensional spatial relations and the acquisition of two-dimensional representational concepts is indicative of some lack of homogeneity within stage development. Flavell (1981) has pointed out that heterogeneity may occur because many cognitive concepts may not be related by a reciprocal mediation process that would enable the concepts to share a similar level of cognitive development. In the development of realistic drawing ability knowledge of three-dimensional spatial relations would seem to some degree independent of the acquisition of representational concepts for drawing.

In summary, the evidence presented about the acquisition of drawing concepts is consistent with formulations of stage development as discussed by Flavell, in that conceptual homogeneity can be found in combination with some degree of heterogeneity within stages. Moreover, the discontinuity originally proposed by Piaget and Inhelder between six- and nine-year-old age levels in the acquisition of drawing concepts is less extensive than they have suggested. The development of drawing ability can be characterized by a qualitative shift to higher-order reasoning and a similarity in conceptual response at given age levels because of the limitations of the information processing capacity of children. At the same time, some of the drawing concepts involved in drawing ability may be independent and non-reciprocal so that,

for example, knowledge of three-dimensional spatial relations is more advanced than knowledge of representational concepts within age groups. Consequently, the variety of cognitive processes involved in the development of drawing ability forms a less tightly woven matrix of information processing than is suggested by traditional stage developmental theory. The fact that training in representational models does improve drawing performance suggests that the mastery of these processes may not be readily achieved by untutored children.

Children's Development of Drawing Scripts

Interviews with some of the children were directed towards delineating their thinking about the drawing process. Content analysis of these interviews was done in terms of the emphasis which the children themselves placed upon characteristics of cognitive processes involved in their graphic productions. The results of the analysis suggest that the spontaneous cognitive processes of children while drawing may be best described in terms of script models.

As previously discussed (pp. 25-27), a script is a dynamic reconstruction process which integrates information from a group of experiences into a sequence of events ordered by time and enablement conditions. The content of scripts is more likely to contain descriptive information detailing any kind of knowledge of the event, rather than being limited to the essential defining characteristics. Also, the organization of scripts involves both hierarchical and non-

hierarchical structuring of information (Minsky, 1975; Nelson, 1980; Schank, 1980; Schank & Abelson, 1977).

The content analysis of children's interviews about the drawing process revealed the following kinds of information to support this proposition. Children reported elaborate associations that usually entailed a time-ordered sequence of events (e.g., first you dig the hole; then you plant the seeds; and finally, when it doesn't rain, you water the plants). The children's reports of production strategies also included time-ordered sequences for executing the drawing techniques. For example, one method reported to accurately depict occlusion was to first draw both shapes and then to erase the occluded parts of one figure. Children also indicated knowledge of enabling processes; at both age levels they reported representational concepts and production strategies for linear perspective, paying particular attention to occlusion and convergence concepts.

The argument can be made that early scripts are incomplete cognitive structures with missing, erroneous, inaccurate and inappropriate information. With greater cognitive maturity children would be expected to develop more successful scripts. In fact, deficits in early scripts were found to be more pronounced in children's enabling processes than in their sequencing of these processes at the age levels studied. Incomplete, erroneous, and inaccurate accounts of enabling processes about occlusion were common with six-year-old children and when both age groups reported

their comprehension of convergence in realistic drawing.

In addition to evidence of time-ordered sequencing and enabling processes, the children's reports demonstrate some of the general qualities uniquely attributed to scripts. The content of their reports includes typical knowledge in addition to the defining knowledge of the object or event being drawn. The constant reference to a neighbor's house or a grandmother's garden suggests the wealth of information categorized in simple associations. Elaborated associations explicitly demonstrated the richness of the conceptual background contributing to the drawing process; one child recalled trips to the park in order to recall and organize information necessary for the construction of a tree. Many children discussed playing outdoors in a variety of situations to assist in organizing the drawing of running and jumping figures. Spatial locations, evocative descriptions of people and events, and statements of feeling were combined in elaborated associations, revealing the abundance of experiential knowledge usually involved in the drawing process.

Children's reports also indicate that the organization of their drawing concepts combines both hierarchical and nonhierarchical conceptual structures. The hierarchical organization of children's drawing concepts is shown by their choice of elements. The people digging in the garden had heads, arms, and legs, and the houses (with a tree out front) had sides and roofs. In hierarchical organization these subparts do not properly exist without the whole to which they

belong. Non-hierarchical organization of knowledge does, however, consist of wholes with components that have an independent existence. Thus, birds and their nests can appear independently of trees, and a sun can shine over gardens, houses, and many other scenes.

The evidence of children's reports supports the proposition that drawing scripts are serving at least two functions. First, scripts appear to function as mnemonic devices for recalling the relevant content and context of drawing material. People, objects and activities are reorganized in conceptual chunks consisting of a variety of information about spatial locations, relevant figures and activities, and emotional content. Secondly, drawing scripts also appear to have an instrumental function, in that their construction will dictate production techniques. The significance of time-ordering in scripts is demonstrated by the success of scripts for directionality when producing geometric figures and scripts for occlusion when producing linear perspective.

In summary then, the spontaneously occurring cognitive processes contributing to the development of children's drawing ability may be more powerfully described by conceptual forms called scripts. Moreover, the drawing script model may be useful for expanding the conception of children's cognitive development.

In conclusion, the purpose of this investigation was to delineate the cognitive processes and structures, as well as

the contents, of children's development of drawing ability. The results provide a window on the conceptual complexity that drawing performance requires from children. Drawing ability combines both arbitrary and non-arbitrary forms of resemblance to the real world. Knowledge of three-dimensional spatial relations is necessary but not sufficient for children to produce realistic drawings of spatial relations. In addition to knowledge of three-dimensional spatial relations, children are developing a two-dimensional representational "language" for symbolizing spatial concepts. Spontaneously occurring cognitive processes involved in drawing ability can be described as conceptual forms called scripts, which can be viewed as developing within the framework of a Piagetian stage development model as modified by Flavell. Finally, the fact that training by the use of representational models improves drawing performance indicates that children can more adequately master realistic drawing when they are provided with relevant learning experiences.

FOOTNOTE

[1]"Arbitrary forms of resemblance" and "non-arbitrary forms of resemblance" are the terms used in the literature to refer to conventional resemblance and perceptual givens, respectively.

Table 1

A Chi-Square Analysis of the Relationship Between the Construction of Three- and Two-dimensional Spatial Concepts

Three-Dimensional Concepts Test Scores	Spatial Drawing Test Scores: Poor 0-7	Spatial Drawing Test Scores: Other 7.5-36	
Other 0-30	19 (15.5)	2 (5.5)	21
Good 31-36	34 (37.5)	17 (13.5)	51
	53	19	72

$\chi^2 = 3.3$ n.s. df = 1

Table 2

Drawing Familiar and Novel Figures--*F* Values of the Main Effects of the Analysis of Variance for Post-tests 1 and 2

Variables	F Value	
	Post-test 1 Familiar Figures	Post-test 2 Novel Figures
Age	14.60**	23.90**
Training condition ...	6.07*	N.S.
Time-tested	5.90*	N.S.
Drawing type	N.S.	39.20**

*$p <$ .025
**$p <$ .001

Table 3

Mean Drawing Scores of Age Groups

by Training Conditions

	Drawing Scores		
Age Groups	Pre-test baseline measure	Post-test 1 familiar figures	Post-test 2 novel figures
Six-year-olds			
Training A	5.69	8.22	5.94
Training B	4.19	3.86	4.47
Nine-year-olds			
Training A	7.53	12.72	8.94
Training B	9.50	7.06	9.19

Note. The mean score represents the combined score for two drawing figures. Maximum possible score is 36 points.

Figure 1

Models Used in Representational Drawing Training Condition A--Running Person

Figure 2

Models Used in Representational Drawing Training Condition A--House With a Big Tree Right by the Front Door

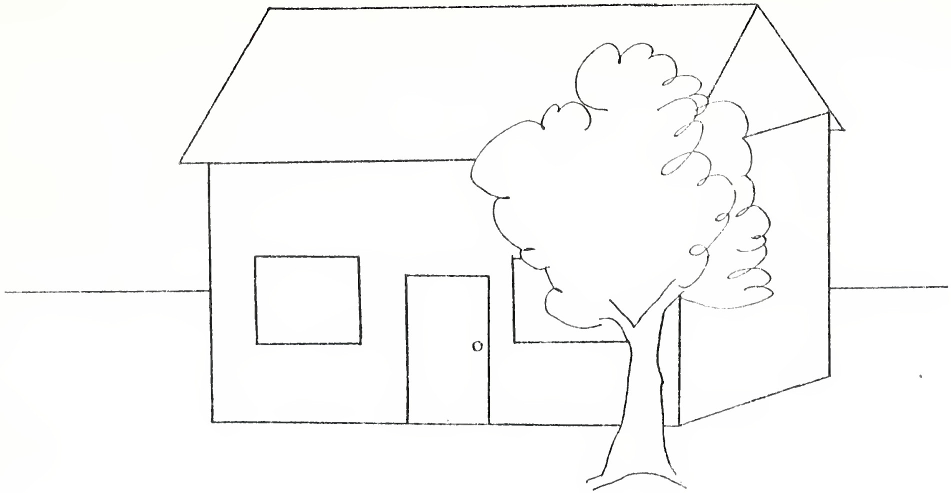


Figure 3

Models Used in Representational Drawing Training

Condition A--Person Sitting on a Rock

Figure 4

Models Used in Representational Drawing Training

Condition A--Bridge Over a Stream

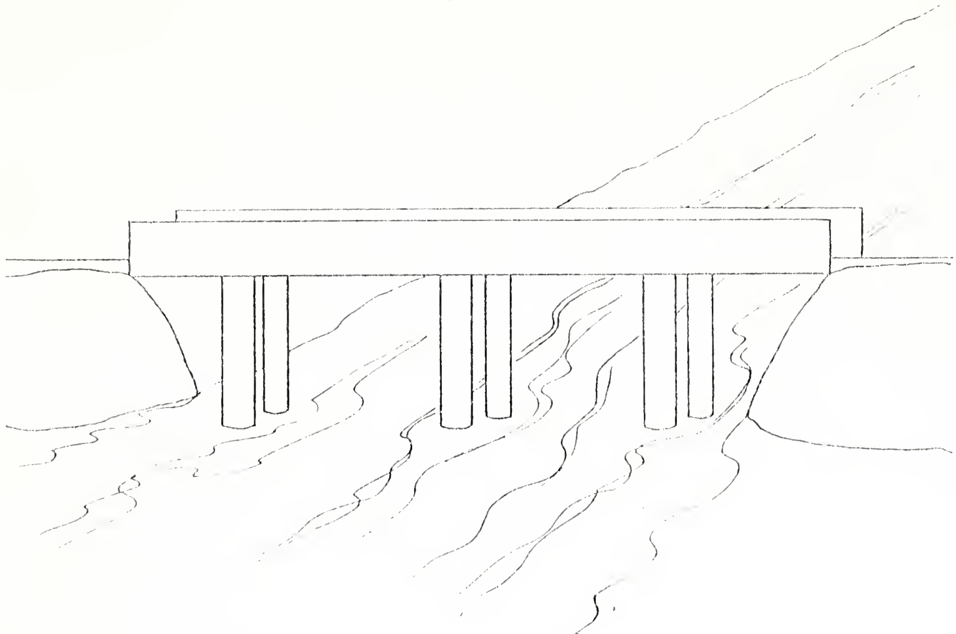


Figure 5

Examples of Children's Drawings

of a Running Person

3 points

7 points

Figure 5 - Continued

14 points

24 points

Figure 6

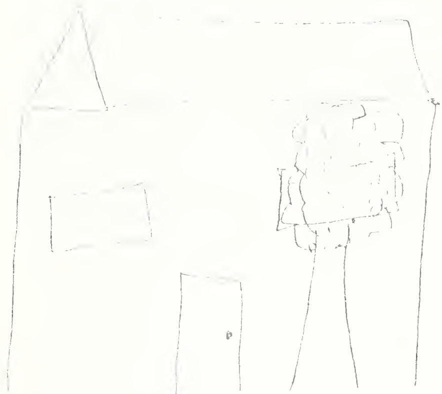
Examples of Children's Drawings of a House

with a Big Tree Right by the Front Door

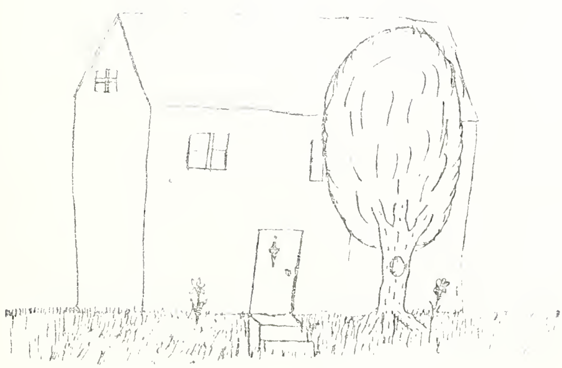
4 points

8 points

Figure 6 - Continued



16 points



24 points

Figure 7

Examples of Children's Drawings of

a Person Jumping Rope

7 points

10 points

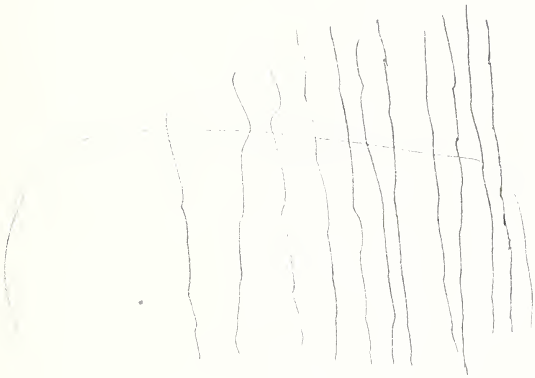
Figure 7 - Continued

15 points

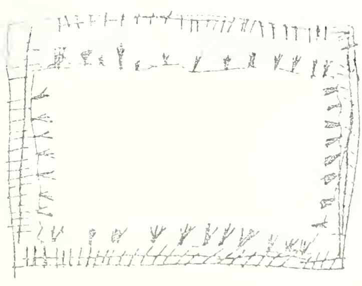
24 points

Figure 8

Examples of Children's Drawings of a Garden with a Fence All Around It

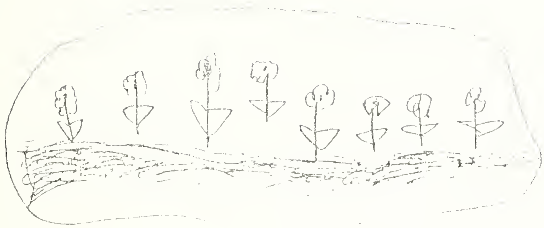


0 points

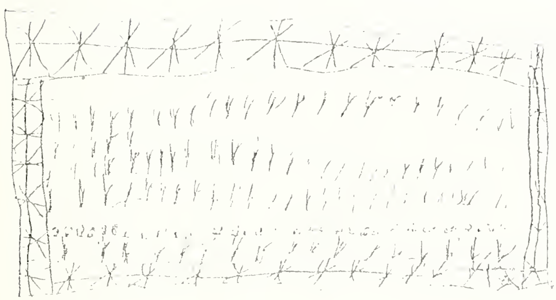


0 points

Figure 8 - Continued



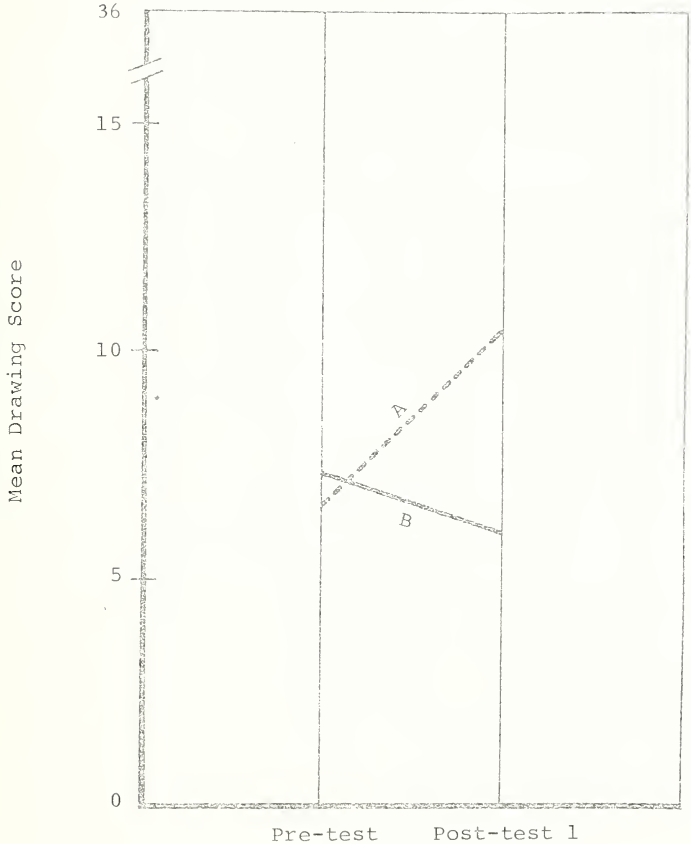
4 points



8 points

Figure 9

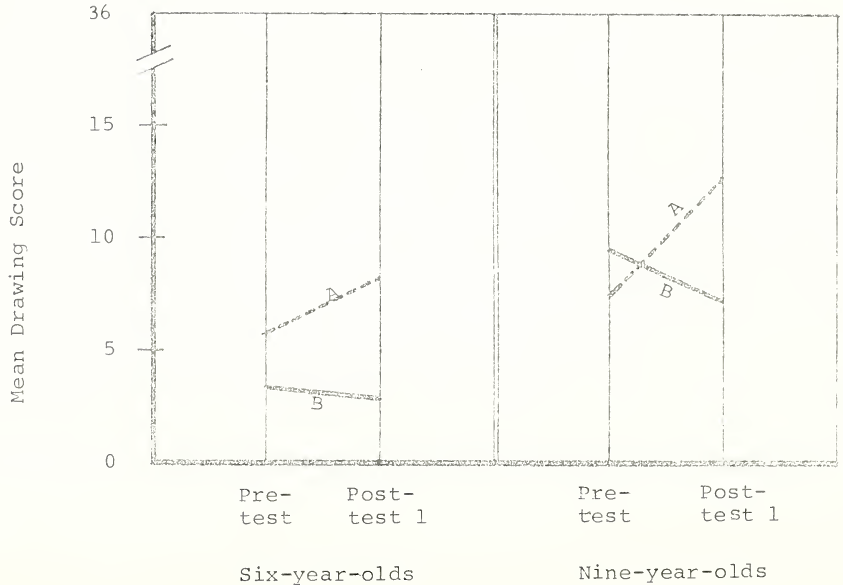
Drawing Familiar Pictures: A Training Condition by Time-tested Interaction



F (1,68) = 26.62, p< .001

Figure 10

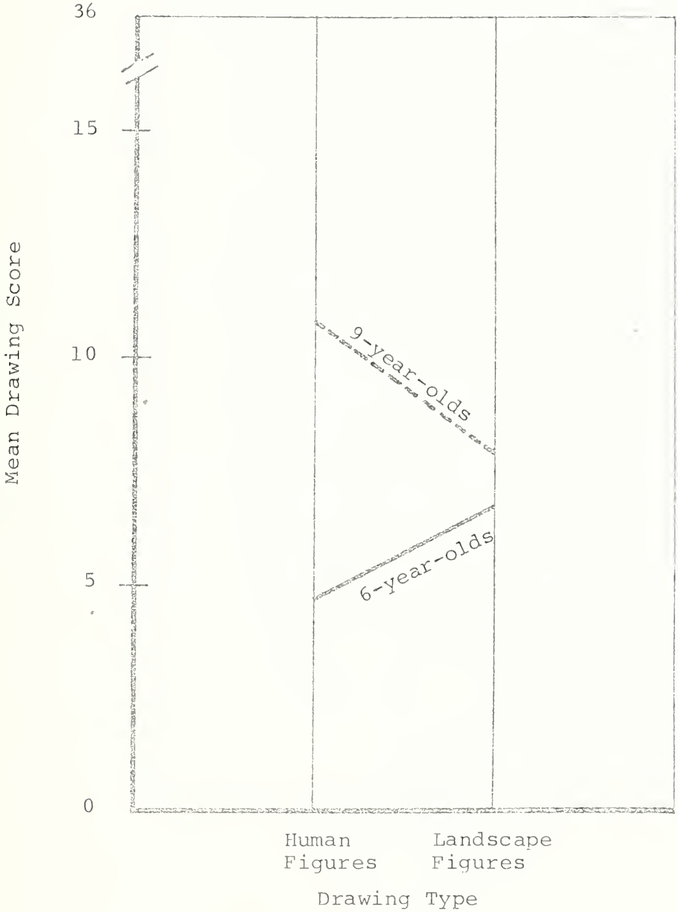
Drawing Familiar Pictures: An Age by Training Condition by Time-tested Interaction



F (1,68) = 5.51, $p < .025$

Figure 11

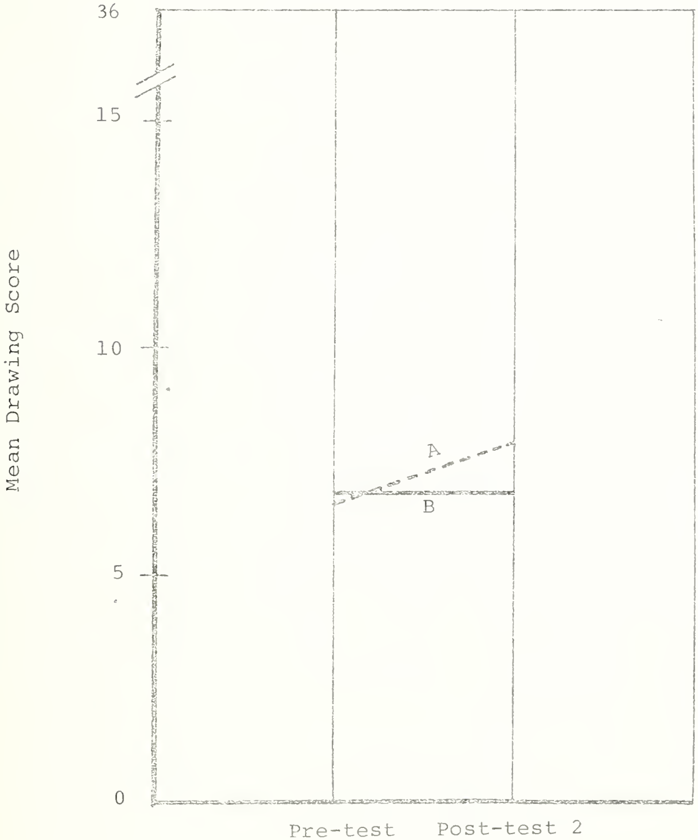
Drawing Familiar Pictures: An Age by Drawing Type Interaction



F (1,68) = 18.30, $p < .001$

Figure 12

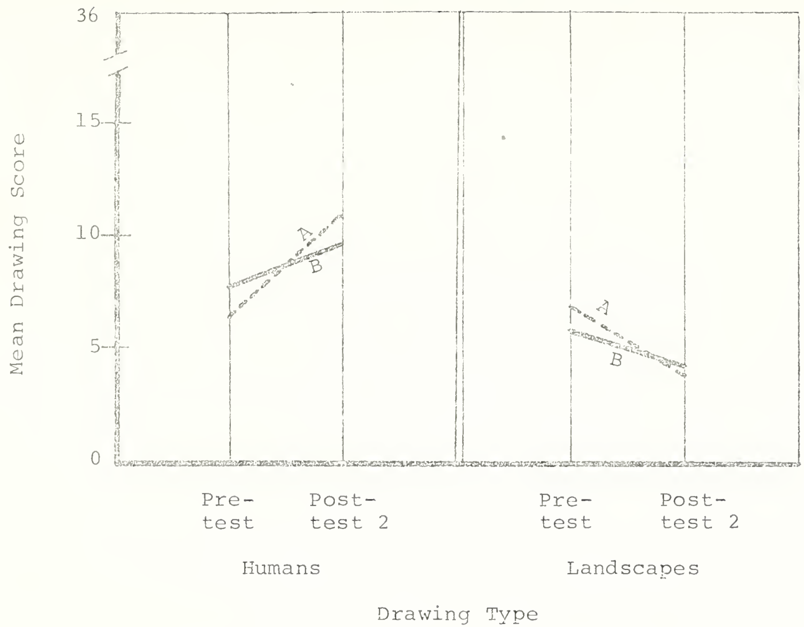
Drawing Novel Pictures: A Training Condition by Time-tested Interaction



F < 1.

Figure 13

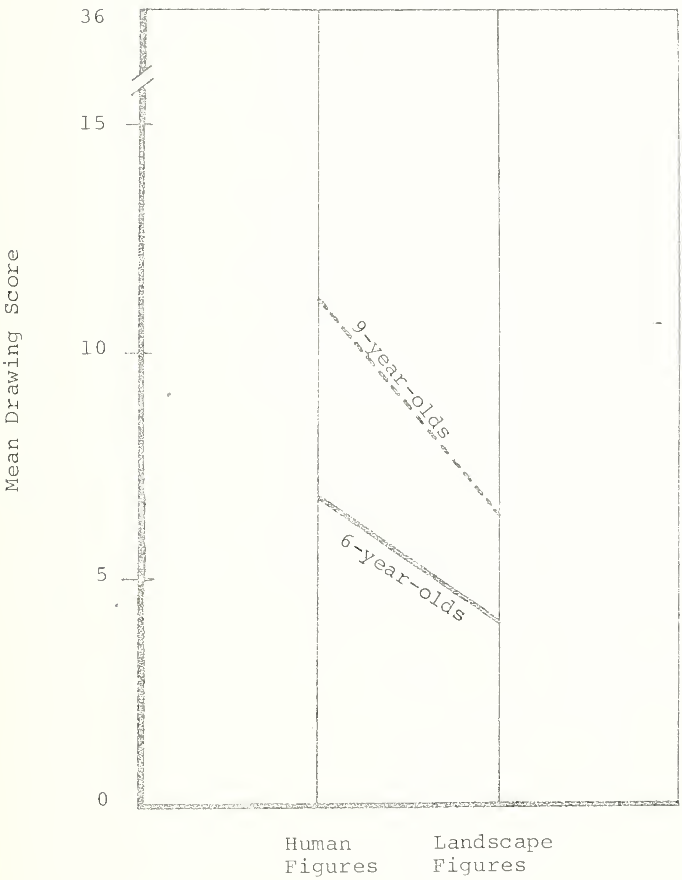
Drawing Novel Pictures: A Training Condition by Time-tested by Drawing Type Interaction



$F\ (1,68) = 6.17$, $p < .025$

Figure 14

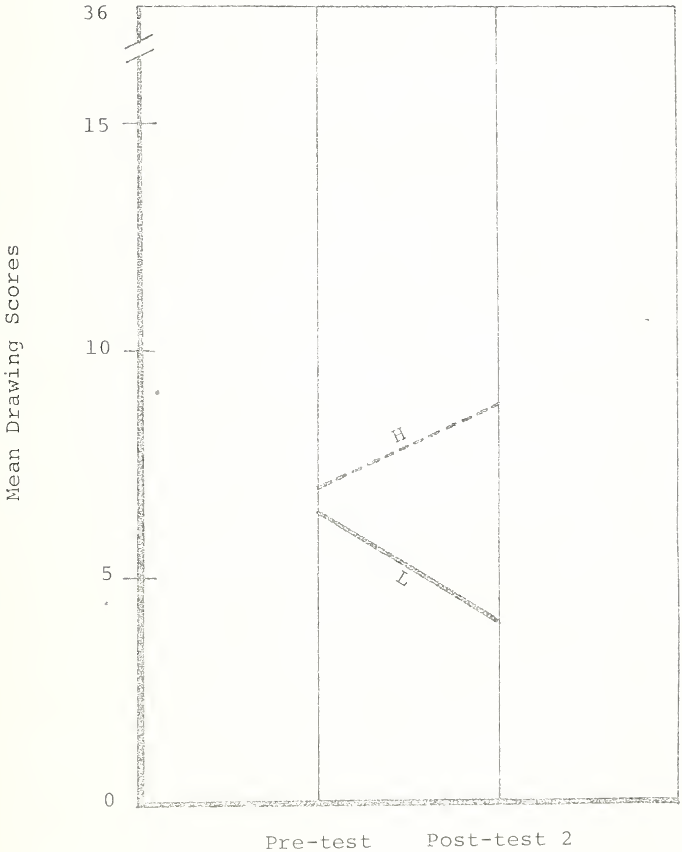
Drawing Novel Pictures: An Age by Drawing Type Interaction



F (1,68) = 6.47, p< .025

Figure 15

Drawing Novel Pictures: A Time-tested by Drawing Type Interaction



H = human figures

L = landscape figures

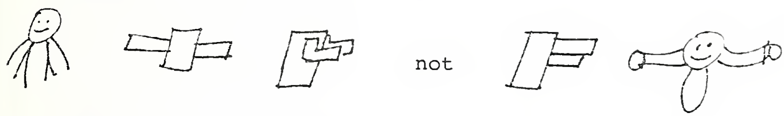
F (1,68) = 58.94 $p < .001$

APPENDICES

APPENDIX A. CODING CRITERIA FOR THE RUNNING PERSON

Orientation of the parts to another part

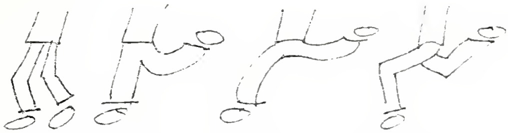
1. One arm should extend from each side of the torso.



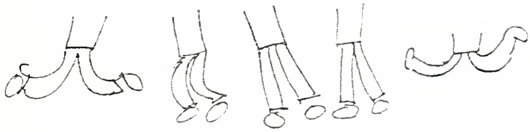
2. One or both arms should be bent.

3. At least one leg should be bent away from the ground plane. This means that the long axis of the leg and the long axis of the foot of the same leg must be angled away from the ground plane. In addition, the leg must be bent.
   The ground plane will be established by a line depicting the horizon or a running path or by the bottom of the page alone.

4. The legs must be bent in a plausible running position.



not

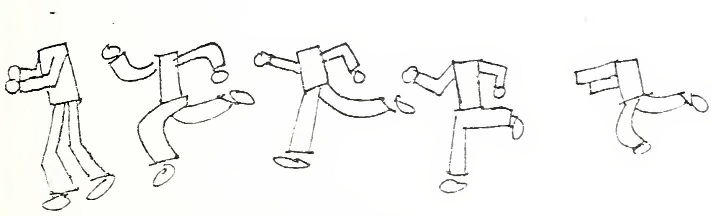


Single point-of-view (Orientation
of the parts to the whole)

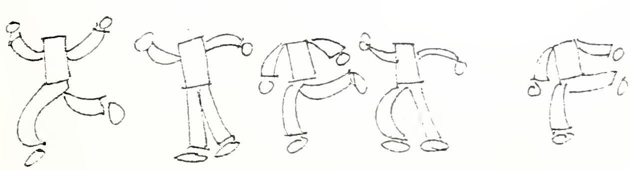
5. The head must be in profile. Only one eye should be seen and the mouth should extend to the side of the head. The nose may be absent.

not

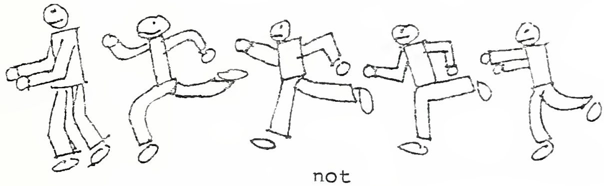
6. Considering only the arms and legs, a side-view of the runner should be depicted. In addition, arms and legs should be plausibly bent. Ignore specific occlusion errors.



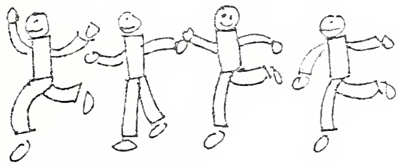
not



7. All elements combined must be depicted as though seen from a station point at the side of the figure. The arms and the legs should be plausibly bent. Ignore occlusion errors.



not

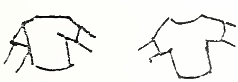


Occlusion

8. The arms should be drawn indicating overlap at the shoulders.

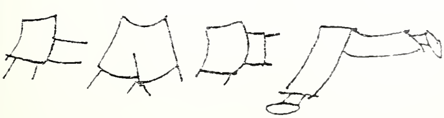
not

9. The arms should be drawn indicating side view occlusion so that inappropriate parts are not visible.

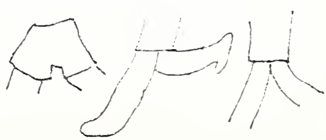


not

10. The pants legs should be drawn indicating side view occlusion at the shorts so that inappropriate parts are not visible.



not

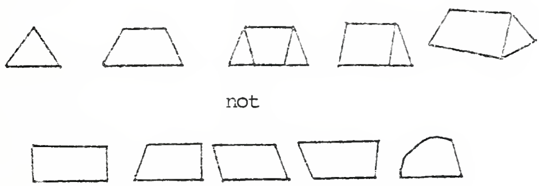


APPENDIX B. CODING CRITERIA FOR THE HOUSE

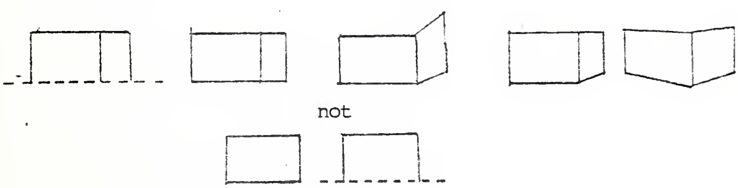
WITH A TREE RIGHT BY THE FRONT DOOR

<u>Orientation of the parts to another part</u>

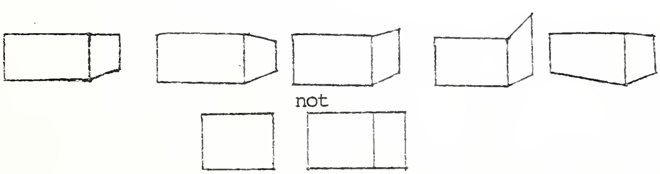
1. The exterior sides of the roof should be angled in plausible opposite directions.



2. At least two sides of the house must be depicted either explicitly or implicitly by the edges of the page.

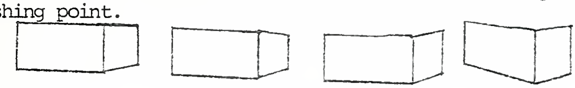


3. The bottoms of the sides of the house should not be parallel.

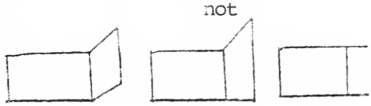


<u>Single point-of-view (Orientation of the parts to the whole)</u>

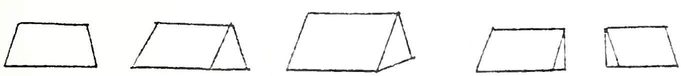
4. Consider only the sides of the house. The sides of the house should be drawn as though seen from a single station point using one or two vanishing points. This means that the lines indicating the top and bottom of at least one side of the house should converge toward a vanishing point.



not



5. Consider only the roof of the house. The roof of the house should be drawn as though seen from a single station point. This means that the lines indicating the ends of at least one side of the roof should converge toward a single vanishing point. If the second side of the roof is visible, a plausible gable should be depicted.



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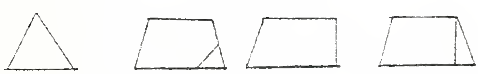
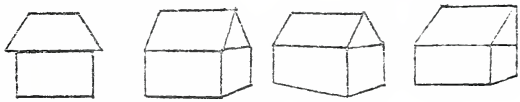
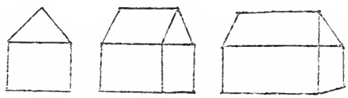


6. All principal angles combined to depict the house must be drawn as though seen from a single station point.



not



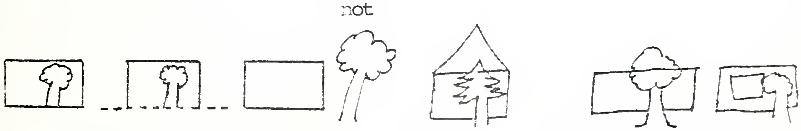
7. <u>Occlusion</u>

The tree should overlap the house at least 1/16 square inch.

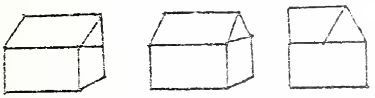
not

8. If the tree overlaps the <u>house</u>, then no more than 1/16 square inch of the house should be visible through the tree. But if the tree does not occlude any explicit feature of the house, then no credit is given.

not



9. Two sides of the roof should be visible and only one complete and plausible gable should be visible at the side of the roof.



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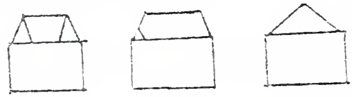
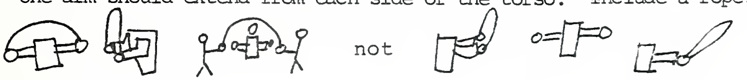


APPENDIX C. CODING CRITERIA FOR THE PERSON JUMPING ROPE

<u>Orientation of the parts to another part</u>

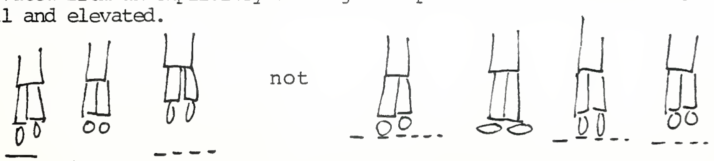
1. One arm should extend from each side of the torso. Include a rope.



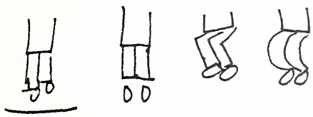
2. Both arms should be bent unless the arms are lowered from the shoulders so that they extend no more than 35 degrees from the axis of the torso.

3. Both legs should be bent away from the ground plane. This means that the long axis of the legs and the long axis of the feet of the same leg must be angled away from the ground plane. In addition the legs must be bent at the "knee."
 The ground plane will be established by a line depicting the horizon, ground level, or by the bottom of the page alone.

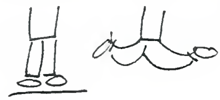
Alternatively, both legs may be straight, but in this case the toes must be depicted as extended towards the ground plane and elevated from it so that the jumper is shown at the height of the jump. Any oval angles away from the horizontal qualifies as an extended toe. Circles may count as extended toes only if they are depicted as elevated from an explicitly drawn ground plane. Both toes must be oval and elevated.



4. The legs must be depicted in a plausible jumping position--either bent or extended.



not

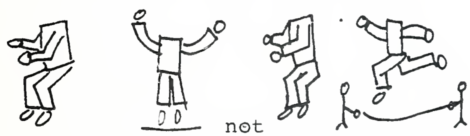


Single point-of-view (orientation of the parts to the whole)

5. The head should be drawn in a frontal, profile, or 3/4 view position. The nose may be absent, but eye(s) and mouth must be present.

not

6. Considering only the arms and legs, a frontal, profile, or 3/4 view of both arms and legs together should be depicted in a plausible jumping position. Overlap of the shoulders should be correct.



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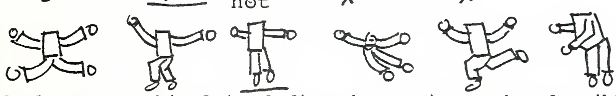
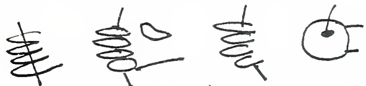


7. All elements combined (excluding the rope) must be plausibly depicted as though seen from the side, at an angle to the side, or from a frontal station point during jumping.

not

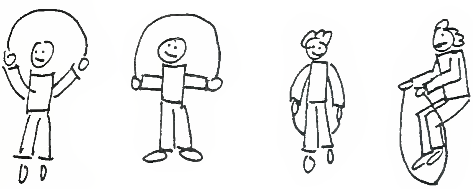
Occlusion

8. Fingers or explicit indication of a closed fist must be present to code. The rope should overlap the hands of the jumper or the turners in a plausible orientation.



not

9. If the rope is underneath the feet or otherwise below the waist: 1) the arms must be bent or straight as indicated in criteria 2; 2) the legs must be bent; and 3) the grasp must occlude the rope. If the rope is overhead or otherwise above the waist the arms and legs need not be plausibly bent, but the grasp must occlude the rope.



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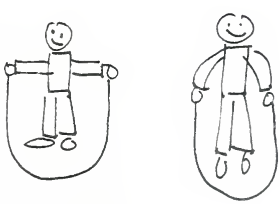
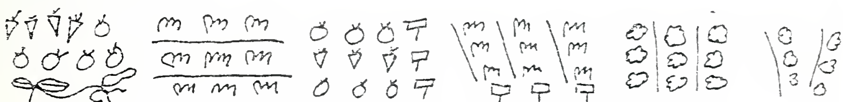


APPENDIX D. CODING CRITERIA FOR THE GARDEN

SURROUNDED BY A FENCE

<u>Orientation of the parts to another part</u>

1. At least two upright objects other than fence must be depicted in a generally upright position relative to the ground plane established by the plants (independent of the ground plane established by the fence).



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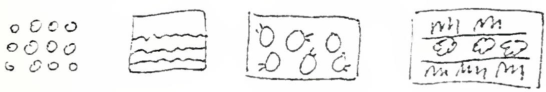
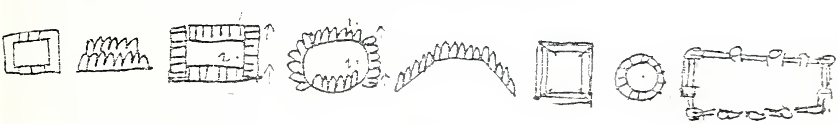


2. At least two sides of the fence must be depicted in an upright position relative to the ground plane established by the fence (independent of the ground plane established by plants). If the fence is circular, approximately one-half of the fence must be depicted in an upright position. The fence does not need to be convergent. Fence sides must be fairly clearly fence sides.



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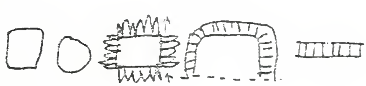
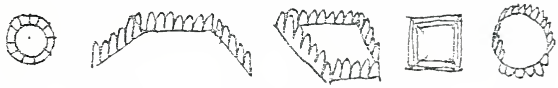


3. At least three sides of the fence (or approximately 3/4 of a circular fence) must be depicted in an upright position relative to the ground plane established by the fence alone.



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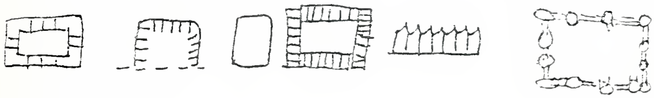
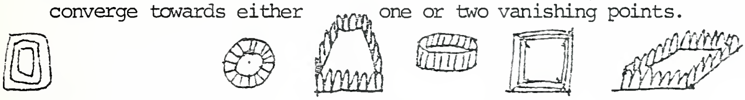


Single point-of-view (orientation of the parts to the whole)

4. Consider only the fence. All four sides of the fence combined must be depicted as though seen from the same station point so that lines converge towards either one or two vanishing points.



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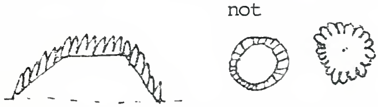
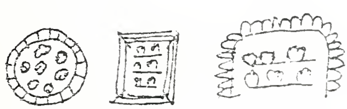
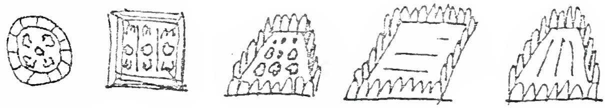


5. Consider the plants and the fence together. The plants and at least two sides of the fence (or one-half the circular fence) must be depicted in an upright position on the same ground plane so that appropriate lines converge toward vanishing points.

not



6. Consider the plants and the fence together. The plants and the complete fence combined must be depicted as though seen from the same station point so that lines converge towards either one or two vanishing points.



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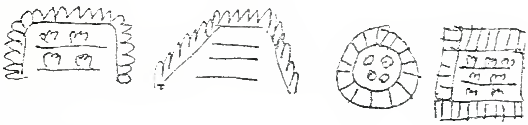
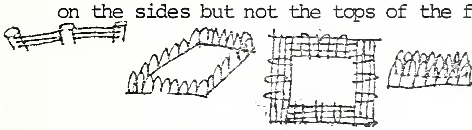


Occlusion

7. At least one side of the fence should overlap another side at least 1/16 square inch. Alternatively, plants should overlap the fence at least 1/16 square inch. Also code overlap of wire or fence slants on the sides but not the tops of the fence posts.



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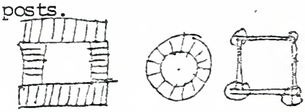
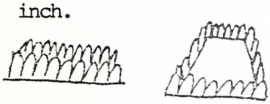


8. Where the sides of the fence should be joined, no more than 1/16 square inch of one side should be visible through the other side. Alternatively, plants should overlap the fence at least 1/16 square inch.



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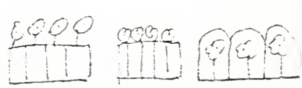
Also, if the plants are close enough to occlude the fence or vice versa, then appropriate occlusion should occur so that inappropriate parts are not visible or avoided.

not



APPENDIX E. CHOICE OF ELEMENTS

#34 - YWF

I. How would you draw a picture of a person digging in a garden?
C. I would make the garden and make the man and have the shovel and make him digging-----and digging a hole to put the stuff in.
I. Well where would you start your picture?
C. Where the house stopped and the yard stopped. I would start digging then. I would make a garden-----until I got so tired of digging I'd just stop and the next day I'd dig some more.
I. No, I mean how would you start your picture? What would you draw first?
C. I would draw the garden and then the man with the shovel digging.
I. And what else would you do?
C. And then in the picture where you fill in the hole I'd put one or two little seeds.

I. I want you to draw a picture of a person digging in a garden and tell me what you're doing as you go along.
C. I made the garden.
I. That long line is the garden.
C. And then the dirt.
I. Where did you say the dirt was?
C. Underneath that long line going across the page. Okay, here's your person. You draw the head and then the body and then the legs and then the arms. And there's his face, his eyes, and mouth.
I. What are those dots?
C. The seeds that he planted.
I. Oh, the seeds, ok. Can he see the seeds from there? He can? He has a lot of seeds doesn't he? What kind of seeds did he plant?
C. Beans and carrots and corn.
I. Ok, what else can you tell me about your picture?
C. (inaudible)
I. The seeds were sitting in the ground and he dug them up with a shovel and put them in the ground. Ok, which way is that man facing?

I. How would you draw a picture of a person digging in a garden?
C. I would make the garden and make the man and have the shovel and make him digging-----and digging a hole to put the stuff in.

#19 - YBM

C. He got a short--shirt on.
I. Ok, that's where the shirt ends.
C. Um-hm. Here's the head band right here. Here's some sweat. He's working too hard.
I. He's sweating on his face. And what's growing in that garden? Now what are you putting in?
C. Cucumber, carrots, watermelon and another carrot. Watermelon, cucumber, carrot, carrot. (in order on left side)
I. Ok.
C. (And the watermelon on the right)

I. Tell me about your picture as you go along.
C. This is his hair. And that's his face.
I. And what did you draw first on his face?
C. His eyes and his nose and his mouth.
I. Ok. (drawing)
C. This is his body. This is the legs. This is his shoe.
I. Now his arm, his other arm.
C. His hands.
I. His hands.
C. His shovel.
I. The shovel.
C. ------------------part
I. It's what?
C. That's the silver part on the shovel.
I. Um-hm.
C. His pants-----and this is the fence (drawing). Dirt bombs.

C. A shovel and the sky.
I. The sky?
C. And the clouds.
I. Uh-huh, anything else?
C. Yeah.
I. What?
C. Put a gate around him and the thing and make a door on the gate. . .and put a dog outside.
I. A dog outside?
C. Outside the fence.
I. Why would you put a dog there?
C. I'd put a--keep him around the yard so he won't mess with the garden. I'd put a square fence around him and give him dog food.

I. Well, how would you draw that?

C. Put a man with a work hat and have a shovel in his hand and digging in the dirt.
I. Where would you start?
C. On the man.
I. What part of the man would you draw first?
C. The head.
I. The head? And then what would you do?
C. The hat and the body.
I. Um-hm.
C. And then the shovel and the dirt.

I. What about the garden itself?
S. Draw vegetables--that's good for you.
I. Mm-hm.
C. And like black-eyed peas and watermelon, cucumbers, squash, vegetables, just like that.

I. These are the dirt bombs.
C. Um-hm. This part up here is the sky.
I. Above the fence?
C. Um-hm. This is the sky, right here.
I. Ok.
C. Put a cloud, cloud and sun. (drawing)
I. Are you all through? Now show me where the fence is.
C. Here, here, and here, but it starts right here. And here's the fence. And I put room right here for the sky.

I. What are you drawing now?
C. His number on his shirt.
I. Oh.
C. Ten.

#58 - YWF

I. Well, think about it. Where would you start?
C. Digging.
I. Well what would you draw first?
C. The people.
I. The person who was going to be digging? Ok, and what part of the person would you draw first?
C. The head.
I. Um-hm.
C. And the hair, and the legs, then the arms, then the clothes, and then I'd start on the dirt.
I. You'd what? What did you say about the dirt?
C. Start on the dirt.
I. You'd start on the dirt. Ok. Then what would you do? Think about it. What else would you put in your picture?
C. Trees, and a house, a garden.
I. What would you put in the garden?
C. Tomatoes and corn and squash and peaches and that's all.

I. I'm going to give you a piece of paper and some pencils. I want you to draw me a picture of a person digging in a garden, and tell me about it as you go along. Tell me what you're doing.
C. (drawing) This looks like a cricket. That's a cricket.
I. Ok, that's all right. You drew the head first, and then the hair. Is that right? And now what are you doing?
C. Making some more hair.
I. Ok, around the face. (drawing) Now what are you going to do, now that you've drawn the head and the hair?
C. And the dress.
I. The dress, ok. It must be a lady, hm?
C. A lady that looks like a lady, gonna dig a hole and put a tree in it.
I. Oh. You drew the legs, now what's that?
C. Hand and arms.
I. Her arms and her hand, yes.
C. That's her clothes.
I. Her what?
C. Her clothes.

I. What's that?
C. Dirt.
I. Oh, that's the dirt. Is the dirt in her hand?
C. Yeh, she's diggin it, there's the hole. She's digging the dirt out of the hole and putting it up in a pile.
I. Oh, I see. She's digging it with her hand, out of the hole and she's going to put it in a pile. Ok. (drawing) What's that?
C. Bows on her shoes.
I. Bows? That's pretty.
C. I'm finished.
I. What about your garden?
C. Oh-oh.
I. You're going to put a person digging in the garden.
C. The dirt. (drawing) First tomatoes.
I. In the right hand corner is tomatoes.
C. (drawing) Corn and apples.
I. Whatever you want.
C. Apples. (drawing) These is all the dirt, and plums.
I. Ok.
C. Peaches, tomatoes. That's the peaches and that's tomatoes.
I. Um-hm.
C. And--I can't think of any more.

I. And what's that?
C. Tree.
I. Is that in the garden too?
C. Uh-uh.
I. Where is it? How far is it from the garden?

C. Real far.
I. It's real far? Well, is the lady in the garden?
C. Yeh, no.
I. Where is she?
C. Standing beside the garden and puttin them in and pickin the vegetables out.
I. Ok. Is this the garden, this little area down here that you have a line, does that enclose your garden? These two lines, do they enclose your garden? Is that where your garden-----
C. This is the fence.

I. Um-hm, ok. Well, how did you know where to start your picture?
C. I started in front of the fence first, and then the vegetables.
I. And what about the lady?
C. I started on her head, then go to her hair, then her dress, then her legs and shoes, then her arms and her bow on her shoes. That's one. This is number one.

#43 - YBM

I. Tell me how would you draw a picture of a person digging in a garden?
C. You make the head first and then the neck, make the whole body and then get a shovel and a rake and rake the whole yard and then shovel, put the seeds in, then pour some water on it and it'll grow.
I. Oh, ok. How would you make it look like the person was digging in the yard?

I. (pause) Can you tell me how you would do that? (pause) Think about it. (pause)
C. The person is digging up the grass and then when they get tired they rest for a while and then they get ready and do it again.
I. Oh, ok, and when would you draw the garden itself? (pause) Would you draw the person digging first or the garden?
C. The person.
I. And then you'd draw the garden?
C. Yuh.
I. And what would you put in the garden?
C. Seeds, tomato seeds, onion seeds, watermelon seeds, banana seeds.
I. Banana seeds?

I. Anything else that you would put in the garden? Or in a picture of a person digging in a garden?
C. -------the sky.
I. You'd put the sky.
C. And a house.

I. Now the garden. Ok.
C. (inaudible)
I. What's that?
C. That's the-----was on it.
I. The wheat.
C. Yeh, it was under the bottoms.
I. Under the rake?
C. This is the watermelon.
I. The watermelon? Ok, you got the watermelon.
C. The onion. The tomato------another watermelon.
I. Another watermelon.
C. Another onion.
I. Onion (bottom of the picture from the left), leaf, watermelon, onion, tomato, watermelon, onion, tomato, lettuce.
C. Then another tomato, another lettuce.
I. Lettuce, you said?
C. And that's it. Put the sky.

I. I see you're drawing the person's head and the eyes and the nose and the mouth. And the neck. Is that right? Yes? (drawing) You drew the arms and then the legs--the feet.
C. I put the shovel in his hand, and------(drawing).
I. That's the shovel in the right hand. And what's in the left hand?
C. A rake.
I. A rake.
C. Now the garden.

#41 - YWF

C. (drawing) I'm going to start with the dirt-------- Then I'm going to make some carrots, apples.
I. The line you drew across the bottom of the page is the dirt? Ok and you drew carrots. And what's that?
C. An apple tree.
I. Oh, that's an apple tree. And those are your apples on the tree?
C. Uh-huh.
I. Ok.

C. ---------tree.
I. Don't forget to put the person digging in the garden.
C. Here's the hole, and the person.
I. Well, who is that digging in the garden?
C. My mama.

I. How would you draw a person digging in a garden?
C. Well you start with the head and get down to the feet and then you make the dirt and then you make the shovel and then make a hole.
I. Ok, and what else would you do?
C. Make the face and the clothes.

I. Would you do that last? After you've made the dirt and the hole? Ok, would you put anything in your garden?
C. You can put some carrots and lettuce and apples.

#32 - YWF

I. Tell me how would you make a picture of a person digging in a garden?
C. I would just make it like my mama had a garden last year and she digged a hole so she could put the seeds inside of it.
I. Well where would you start drawing? What part of the picture would you make first?
C. I'd make the garden.

I. To look like your mama? Where would you start?
C. I would start on the head first.
I. And then what?
C. Then I would start on the chest and then I'd start on the waist.
I. The chest and the waist and then what?
C. And then the arms and the legs, and the foots.

I. Anything else you would draw in your picture?
C. Yeah.
I. What?
C. A fence and a scarecrow so the birds won't eat something.

I. Tell me what you're drawing.
C. A garden (drawing).
I. First you're drawing the garden.
C. Um-hm (drawing).
I. And that's the person; the head and the chest, and what's that part of the person?
C. The waist.
I. Her waist? So you're drawing the person from the top to the bottom.

C. Scarecrow.
I. Oh, that's the scarecrow. Now. Now, remember you're going to make the person digging in the garden.
C. That's the scarecrow, right there.
I. Which is the scarecrow? Oh, the first person you drew was the scarecrow.

C. Uh-huh (drawing). Making the fence.

C. Yeah, gotta draw the arms.
I. Oh, the arms, yes. All right what is this part hanging down here to the ground?
C. Her hair.
I. Um-hm. Ok, what are you drawing now?

C. A bird. Ok. and a butterfly.
I. And a butterfly in the lower right hand corner.

C. (drawing)
I. And in the lower left hand corner, what is that going to be?
C. A <u>flower</u>.
I. A flower, ok. What is being planted in your garden?
C. Mmmm, corn, and <u>carrots</u>, and <u>fruit</u>.
I. Fruit, what kind of fruit?
C. Bananas, apples.
I. Apples, anything else?
C. Um-uh.

#20 - YBF

I. Well think about it. Where would you start?
C. With the <u>garden</u>.
I. You'd start with the garden? And what did you draw first?
C. Make some little <u>plants</u>.
I. How would you do that?
C. Just put some <u>grass</u> up.
I. You'd put some grass up? Then what would you do?
C. Then I would make a <u>person</u>.

I. What part of the person would you draw first?
C. The <u>head</u>, the <u>top of the body</u>.
I. Ok, and then what?
C. I don't know.
I. Well, think about it a minute. (pause) Then what would you draw?
C. Mm (pause). I don't know what I would draw.
I. You'd draw the garden and then you'd draw the person. How would you make him look like he was digging?
C. With the <u>shovel</u>.

I. What is that?
C. Some <u>beans</u>.
I. Beans, at the top.
C. <u>Cucumbers</u>.
I. Cucumber?
C. Cucumbers green.-----
I. A stick? What is that for?
C. To hold him up. (stick)
I. To hold what up?
C. The------so you can see it.
I. So you can see the cucumber?
C. The <u>picture</u>.
I. Of what?
C. -------cucumbers.

I. Make a person digging in the garden.
C. I can't make him stand up. I'll have to <u>put</u> him <u>upside down</u>.
I. Well, whatever you think is best.

C. I'll have to turn this upside down. This will be a little girl.
I. Ok.
C. And I'm going to put a part in her hair and she'll have her hair combed and----- (drawing).

#57 - YWF

I. I want you to tell me how to make a drawing of a person digging in a garden. How would you start?
C. ---in a garden----person----shovel like she's digging----a hole like a circle-----dirt, that's all.

I. Are things growing in the garden?
C. Carrots, tomatoes.

I. I want you to draw me a picture of a person digging in a garden, and then you can tell me about it while you're drawing it.
C. That's the garden.
I. And what's that?
C. (inaudible)

#49 - YBF

I. Tell me how would you make a picture of a person digging in a garden.
C. I'd make him with a shovel diggin.
I. Well how would you start your picture?
C. Make a person shoveling--digging up some dirt and then put some seeds in it.
I. Um-hm, and how would you draw the person? What would you do first?
C. I would make the ground.
I. Um-hm, and then what would you do?
C. I would make the person with the shovel.
I. Um-hm, and how would you draw that person, what would you make first?
C. The head.
I. And then what would you do?
C. The arms, then the legs and the hair.
I. The legs and then the hair.
C. Then the eyes.
I. Eyes, yes.
C. Then the nose, then the face.
I. What about the shovel?
C. I'd make it down to the ground, the person holding on to it.
I. Anything else that you'd do?
C. I'd put-----put some seeds down there. And then I'd make them in the house looking out the window and waiting for the flowers to grow.

I. Tell me about it as you go along.
C. That's a person (drawing).
I. Yes, is that the shovel? What is that part right there?
C. She digs.
I. Where is she starting to dig?
C. (inaudible)
I. Oh, this is the spade of the shovel? And that's the handle?
C. (drawing) They're sisters.
I. Oh, they're sisters. What's that?
C. She's holding that in her hand.----

#50 - OWM

I. How would you make a picture of a person digging in a garden?
C. I'd draw him with a shovel and a hoe and dirt piled up behind him.-----
I. Well, where would you start?
C. First I'd draw the garden, then I'd draw the person with the shovel, then the hoe, and then I'd have a pile of dirt behind him.
I. You'd have a pile of dirt behind the person?
C. Um-hm-----shovel it, throw it over his shoulder.

I. What would you draw in it? What kind of stuff?
C. Tomatoes and okra and corn and that's all.
I. And then you'd start on the person?
C. Um-hm, I'd start on his hat first.
I. His what?
C. Hat.
I. His hat?
C. Um-hm.
I. Ok, and then what would you do?
C. Then I'd draw his face and then his body, then his arms, then his legs, and keep on till I get the shovel in there and then the hoe and-----
I. Ok, and that would be your whole picture?
C. No, I'd put my name in the bottom right hand corner.
I. Anything else you would do?
C. Maybe I'd title it, I don't know. Sometimes I title -------, not all the time.

C. All right, now I am drawing the garden.

I. (Pause - drawing) What part of the garden is that?
C. The right side. (drawing) I didn't finish erasing.
I. Ok.
C. That's not so straight either but you'll just have to ----- (drawing).
I. What part is that?
C. Fence.
I. Oh, that's the fence. Ok. (drawing)
I. And what part is that?
C. The side.

I. That's the side of the what?
C. Fence.
I. Oh, that's the side of the fence. (drawing)
I. Ok, and what's that?
C. That's a tomato. (drawing) This will take a long time to draw all those tomatoes.

C. Um-um, they're on the side. I'm going to draw 1 like this. That's a deformed tomato.
I. A deformed tomato?
C. Un-huh, haven't you saw a deformed tomato?
I. Um-hm.
C. Where they're two into one, where they set on the ground. There's the ground.
I. What is that you're filling in there?
C. That's the ground.
I. That's the ground, ok.
C. That's a---- (drawing) and corn. I'm not making whole rows cause I don't feel like it.
I. Ok. (drawing)
C. Now I draw a lot of corn, cause we haven't planted our corn yet.

C. This is going to be the man. This is his hat. I'll draw his hands. (drawing) That's the pile of dirt.
I. Um-hm. So first you drew the man's hat and then his head and the rest of his face and his body, the upper part of his body and then you're drawing the pile of dirt.
C. Um-hm.
I. Ok.
C. Now we go to his belt.
I. His belt.
C. And his legs. Usually I draw the arms before I draw the legs.
I. But today you're drawing the legs first? Why are you doing that?
C. I just wanted to. His feet are too big. (drawing) Those feet are entirely too big.-------- (drawing) There's his arm, one arm. There's his hand and the shovel's in it. There's the other arm. The other hand (drawing) shovel ------
I. What's that?
C. The hoe.
I. Oh, that's the hoe. One looks like the other one should be black too.

C. Ok, I'll draw some more corn. (drawing) Why would anyone be drawing a hole. I mean why would anyone be digging a hole in the garden?
I. And now you're filling in the dirt around the corn.
C. And around the person.
I. And around the person. (drawing)

C. Now what can I put?
I. Are you thinking about what to put next?
C. Um-hum, okra.

#39 - OWF

I. So how did you know what to put in first?
C. You put the sides of it, then the poles, then the flowers.
I. The sides first, then the poles, then the flowers.
C. She's holding that in her-------.
I. What kind of flowers are those?
C. Like lillies or something like that.
I. They're pretty flowers.
C. Thank you.
I. What else is growing in your garden?
C. Like weeds and grass.
I. What's in back of the flowers?
C. The dirt, the-------.

#55 - OBF

I. How would you draw a picture of a person digging in a garden?
C. I'd first draw the person's body and then I'd draw the shovel and then I'd make the shovel diggin in the ground and then on another sheet of paper I'd make another person diggin in the ground and he got it up in his hand.
I. Um-hm, and then what would you do?
C. And then when he had it up in his hand I'd let him put it in the bucket.
I. Ok, and how would you know how to do all that?
C. By thinkin

I. What would it look like if you had drawn all four sides around the garden of the fence?
C. It would look like a real gate around it.

I. Well, what is there to keep people out?
C. Keep people from out of the garden cause they won't step on the flowers and the vegetables.
I. Is it a fence or what is it there to keep people out?
C. It's a fence.

I. But how could you see the person through the fence?
C. By it's be a little door right there and she can walk in and then she can lock it up, lock it back until she finish and then nobody can get in.
I. So you just added a door.
C. Yuh.

#52 - OWF

C. I'd make the person standing on some dirt and a shovel in his hand.
I. Okay, well how would you start? What would you make first?
C. Probably the ground.
I. You'd draw the ground first? And then what would you do?
C. I'd draw ----- his hands and then the shovel -----
I. In drawing the man, where would you start?
C. His feet.
I. You'd draw his feet? And then what?
C. I'd draw ----- and then I'd draw his legs and his belly and his arms reaching down like that. And put a shovel in his hands. But before I drew the shovel I'd finish making his body.
I. His body, okay. What else would you draw?
C. Some dirt in the shovel and clouds and the sun.
I. Clouds and the sun. And how would you know how to show dirt?
C. I'd make it sorta lumpy.
I. Lumpy? What do you mean by lumpy?
C. (inaudible)
I. Well you mentioned making little lines, you mean you'd make little wavy lines across the paper.
C. Um-hm.

I. I want you to draw a picture of a person digging and tell me what you're doing as you go along.
C. ------- digging.

I. How did you go about drawing the garden?
C. ------ and then I put little things sticking up that said what vegetable it was.
I. Growing potatoes.
C. And tomatoes.
I. Tomatoes.
C. Then I put my ---- in there.
I. What do those wavy lines show you?
C. That's where ---- the lines ---- dirt are.

#12 - OWM

I. How would you draw a picture of a person digging in a garden? What would you do?
C. I would draw the garden, then I'd draw the shovel, then -----
I. Then you'd draw the man.
C. Um-hm.
I. Ok, what else would you do?
C. I'd draw some grass and some things growing in the garden.
I. So you'd draw the shovel first.
C. No, I'd draw the garden first.

I. Oh, you'd draw the garden first, then the shovel, and then the man? What part of the man would you draw first?
C. His <u>legs</u>.
I. His legs.
C. Then his <u>body</u>.
I. And what else would you draw?
C. Grass.
I. What about his head?
C. I'd draw that after I drew his body. And then I'd draw some things <u>growing</u>.

I. In a garden. And tell me what you're drawing as you go along.
C. (drawing)
I. Now what's that big square? Is that your garden, the boundary of your garden? And what are those lines going across?
C. The <u>rows</u>.
I. Those are the rows in the garden. (drawing) And now there's the shovel. There's the man's feet, and his legs. (drawing) What is that that you're drawing?
C. Tomato, staked up.
I. Oh, tomatoes staked up. And what's that?
C. <u>Cabbage</u>.
I. Cabbage at the top, tomatoes at the bottom. (drawing) What are those?
C. <u>Watermelon</u>.
I. Oh.
C. (inaudible)
I. And what's that?
C. (inaudible)
I. The bottom you've got grass. Now tell me more about your picture. What is the man going to be digging?
C. He's digging the rows for <u>beans</u>.

I. How about your garden?
C. I made the rows.
I. Where's that"
C. At the end.
I. Oh, the rows, yes.
C. I made a <u>fence</u> around it.
I. Uh-huh. What did you do first?
C. I put the square garden and I put <u>stuff</u>. The rows, and I put the <u>other</u>.

I. What's growing in your garden?
C. Tomatoes, and beans, <u>okra</u>, and cabbage.
I. Where are those vegetables?
C. Inside the garden, in the <u>ground</u>.

#29 - OWF

C. First I would make the <u>garden</u> and then I'd try to make him look like <u>standing</u> up, and then I'd kinda like

make the shovel go down digging and then I'd make half the garden like I'd already dug it and plant seeds.

I. Would you draw the person first or the garden?

C. I'd probably draw half of the garden first.

I. Which half?

C. There'd probably be a fence here and half of the garden back here.

I. Would you draw the half where the person was going to be first? And what about the person?

C. (inaudible)

I. Well when would you draw the person?

C. Right after I got thru drawing------

I. After you got thru with half of the garden or the whole garden?

C. Half of the garden.

I. And then you'd draw the person?

C. Yuh, and then I'd draw back here.

I. The rest of the garden. Well when you drew the person what part of the person would you draw first?

C. The head.

I. The head, and then what would you do?

C. The body, I'd draw the body.

I. Um-hm.

C. And then I'd draw the legs and then one arm and then I'd probably draw one arm down about curved down and then draw the shovel.

I. He uses the shovel to dig.

C. And that's my picture.

I. I'm going to give you a piece of paper, and I want you to draw me a picture of a person digging in a garden and tell me as you go along what you're doing.

C. Right now I'm drawing half of the garden.

I. First you're drawing the first half of the garden.

C. (inaudible)

I. This is the part that's already dug.

C. Yuh.

I. Ok (drawing)

C. Ok, these are some trees that he's already planted. ----- Ok, now I'm drawing the person. ----- He's digging right here and now I'm going to put his eyes and his hair.

I. The last part you're putting is his eyes and his mouth and his hair. Is that your whole picture?

C. Yuh, see he's only got that far.

I. Oh, I see well then is there another part of the garden that he hasn't dug yet?

C. What do you mean? Oh, he hasn't finished his garden, he's still --------

I. Ok, so you drew the garden first and then you drew the person.

C. No, I drew the seed.

I. What has he planted there?

C. Tomatoes, and cucumbers, onions and corn and beans.

#48 - OWF

C. I'm drawing the legs first.
I. You're drawing the legs first, ok. (drawing)
C. ----- the <u>shoes</u>, ----- the body bending over.
I. I see. What are you doing to make it look like it's bending over?
C. ----- it sideways -----
I. You're drawing it in sort of a curve, aren't you? And then you put the head on.
C. And then the <u>face</u> -----
I. Digging in a <u>garden</u>.
C. ----- shovel -----
I. And what are those little wiggly lines?
C. The <u>dirt</u>.
I. That's the dirt, ok. (drawing)
C. (inaudible, drawing)
I. Those lines at the top of the page are all dirt, right?
C. Um-hm.
I. And that circle near the shovel is the hole.
C. And he's happy -----
I. He's happy?
C. Um-hm.

I. How did you know what to do?
C. I started with the legs ----- two straight <u>lines</u> and then I took a <u>curve</u>.
I. A curve rectangle to the body?
C. And I kinda put a <u>hole</u> on it so I could put the head to the <u>neck</u> ----- and then the eye, nose, and the mouth. A <u>dot</u> for the <u>eyes</u> and a dot for the <u>nose</u> and the <u>mouth</u> ----- and then I put another one on like it's behind him, then I drew a ------ for the shovel and then I kinda like a <u>circle</u> and then I started drawing regular lines for the dirt and a big <u>pile</u> of dirt and a hole. -----and then I made shoes.

#1 - OBM

I. Tell me about your garden. What's growing in your garden?
C. <u>Carrots</u> and <u>tomatoes</u>, and <u>radish</u>.
I. Where are they?
C. <u>Cabbage</u>, they're in ------
I. What?
C. (inaudible)
I. Where are the carrots and tomatoes and radishes?
C. Oh, they haven't <u>grown</u> yet.
I. So what are these lines?
C. They <u>planted</u> ----- <u>garden</u> ----- <u>plows</u> -----
I. So what do you see in the picture?
C. ----- a <u>fence</u> around the garden ----- the plows ----- <u>seeds</u> are planted.
I. You see that it's been planted.
C. Yeah.

APPENDIX F. SIMPLE ASSOCIATIONS

#55 - OBF

C. um-hm
I. Did you think about how other people look when you've seen them jump rope?
C. um-hm.
I. Which do you think you were thinking of at the time? Which came to your mind first?
C. How other people jump rope.
I. So you could picture how they look when they jump rope. And that helped you to know how to draw a person jumping rope.
C. Yes.

#29 - OWF

I. I want you to tell me some things about them. How did you know how to draw a person running very fast?
C. Uh- well I've seen some people run fast. Well, I just drew it like I saw ----- some people run, football, basketball, softball, anyplace I saw people run. That's all I can think of.
I. You thought about how people look when they're running?
C. Yeah.
I. And when they're playing different sports?
C. Yeah.
I. Were you thinking about how you feel when you run?
C. (inaudible).
I. No? All right, what about the person jumping rope. How did you know how to draw a person jumping rope?
C. Well, when we go outside the past week we usually jump alone but sometimes we jump together, and I, I, after I do some of my chores that I have to do at home I just take a piece of paper and scribble and stuff like that and practice ---------
I. So you've drawn pictures of people jumping rope before.
C. Yeah.
I. I see. Were you thinking about anybody in particular when you drew that picture?
C. There's this little girl, her name's Lavonne-no, its Elritta Rudd, whe can jump real good and real fast.
I. Does she?

C. And she has a ------- and I was thinking about my cousin and her.
I. You were thinking about Elritta and your cousin, the way they look when they jump rope.
C. Yeah, she usually crosses hers ----- but I couldn't do that.
I. You couldn't draw that. She crosses her arms?
C. Yes, she crosses her arms and she ------ backwards.
I. That's pretty fancy jump-roping.
C. Yuh.

#12 - OWM

I. What were you thinking about when you drew the man or person jumping rope?
C. A person jumping rope.
I. Anybody in particular?
C. Nope.
I. Do you ever jump rope?
C. Mmm, sometimes.
I. Were you thinking about how you feel when you jump rope or how you might look?
C. Mm-mm.

I. What were you thinking about when you drew a person running?
C. A person running.
I. You or somebody else?
C. Me.
I. You thought about how you feel when you run? Do you like to run? Did you think about how someone else looks when they're running fast?
C. Yup.
I. Were you thinking about any particular person?
C. (inaudible)

#52 - OWF

I. What were you thinking of when you drew the picture? What were you thinking of when you drew someone running?
C. I don't know.
I. Were you thinking about yourself running?
C. I was just thinking about a person running.

I. Ok, what were you thinking about when you drew the person jumping rope?
C. Her knees bending back when she was jumping and I was thinking about yesterday how I was jumping rope.

#39 - OWF

I. Yes, okay. What were you thinking about when you drew these pictures of people?

C. I was just thinking about how I could be running down the hill or jumping rope, I just --------- like at different times of the day.
I. You mean you thought about how you looked or felt when you were running or jumping rope?
C. Um-hm.
I. Did you think about how other people look when they're running?
C. Yes.
I. Or jumping rope.
C. Yes.
I. Did that help you to draw a better picture?
C. um-hm.
I. Which did you think about more, yourself doing these things or other people?
C. Other people.

#49 - YBF

I. Were you thinking about someone when you drew the picture, were you thinking about someone you know who jump ropes?
C. (inaudible)
I. Who.
C. My sister.
I. Your sister? Does she look like that when she jump ropes?
C. (inaudible)
I. Did you think about when you were jump roping, how you feel?
C. (inaudible)
I. You did? (Pause) ok what were you thinking?
C. I was going to find someone else to play with while she's talking to a person.

#48 - OWF

I. Tell me, what were you thinking about when you drew the person jumping rope?
C. Me -------- and all of us -------
I. Did it help you to draw the person by thinking about what it was like to jump rope?
C. uh-huh.
I. Did you think about how your friends look when they jump rope?
C. Yes.
I. Do you like to jump rope?
C. Yes.
I. Did you think about how it feels to jump rope when you were drawing the picture?
C. Yeah.

I. How about the person running?
C. She takes me sometimes and we had a cookout and we were running around the block so I remember that a long

ago, how I was running.
I. That's what you were thinking about when you drew the person running?
C. Mm-hm.
I. Ok. Did you think about how it felt to run?
C. uh-huh.
I. Did you think at all about what a person looks like running?
C. Yes I felt like my friend Lisa, she ------- I was thinking about when she was running ------ how she was running.

#1 - OBM

C. We live in an apartment and there's a little round thing around it where the cars ride on and he was jumpin in that --------
I. So you were picturing your back yard or your driveway when you drew the person jumping rope?
C. Yeah, I was thinking of around at my friend's house -------- jumping rope.
I. Is that in the same apartment building?
C. Yes in the same apartment so there's around the back and I was just ----- the back, and the front has a big ------

I. Um-hm. How about the person jump-roping? What were you thinking about when you drew the person jump-roping?
C. My friend's sister.
I. Your friend's sister?
C. Yes.
I. Does she do a lot of jump-roping?
C. Yes.

I. What were you thinking about when you drew a person running?
C. Thinking about a person in a race -------
I. You were thinking about a person running a race?
C. Yes.
I. Have you seen people run races?
C. No.
I. You've thought about what it would look like though.
C. Yes.
I. How about yourself, do you like to run?
C. Yeah.
I. Did you think about yourself running?
C. Yeah ------------- people in a race --------------
I. So were you thinking more about yourself running or other people?
C. Myself and other people and -------- racing.

I. Did you picture her?
C. Yeah, I was planning to draw her with her feets up in the air but I didn't.

I. What did you think about when you thought about her, her feet in the air or her feet on the ground?
C. Her feet on the ground and the rope above her head.
I. So that's what you drew.
C. Yeah.

#43 - YBM

I. It does? Who is that, any particular person in the garden digging? You? Does it look like you?
C. That's my long shirt.
I. That's your long shirt. What else can you tell me about your picture?

I. Were you thinking about how he looks when you drew that picture
C. um-hm.
I. Ok, he looks something like that?
C. He's an old man.
I. What about the person you drew?
C. I just thought of a man digging.

#48 - OWF

I. You can't. Ok, what were you thinking about when you drew the garden?
C. My garden we got in the country.
I. What about the fence? What were you thinking about since you don't have a fence?
C. We've got a fence around our house, around the back yard of our house, and it's big so I just made it.
I. You drew a fence and thought about the fence that was around your house.
C. Um-hm.
I. Does that look like the fence in your house?
C. No ours has --------- and points at the top.
I. And what's this.
C. Round.
I. Round at the top.
C. Uh-huh
I. Have you ever seen a fence like that, like you drew?
C. Yes.
I. Were you thinking about that kind of fence that you had seen when you drew this?
C. Uh-huh.

I. Does that house look like your house?
C. Almost.
I. Almost.
C. Except that the front window it has just one window in my room and the living room has two windows.
I. Were you thinking about your house when you drew the picture?
C. Uh-huh.

#1 - OBM

I. Does that house look like any house that you've seen besides the one in the picture?
C. My friend's house ------ the tree has little things fallin off ---------------
I. What little things?
C. There be some kind of thing that's got a seed on it and then they drop off the tree --------
I. Oh, is that the kind of tree you drew?
C. No, I just drew a tree like a ------- or an apple tree.
I. Do you know of anybody--you say your friend's house looks like that?
C. Yeah and it's got a chimney inside, and when you first drive in the driveway ----- and the sides.
I. Were you thinking about your friend's house when you drew that picture?
C. Yes, and I was thinking about that house that you showed me in the picture.
I. So you were thinking about both?
C. Yeah.

#12 - OWM

I. Does their fence look like that?
C. M. It's not layin down.
I. What were you thinking about when you drew that fence?
C. The next door neighbors.
I. You were trying to copy the next door neighbors fence?
C. Yep, trying to.
I. What about the garden itself, what were you thinking about?
C. My garden?

I. Do you have a garden at home?
C. Um-hm. two gardens.
I. Oh, two gardens. Does it look like that.
C. Yeah but it don't have a fence around it. A path here and then a big garden over here.
I. Do you know of a garden that looks like that? with a fence around it?
C. Yeah, my next door neighbors they got one like that, they just started plantin it.

I. Have you seen a house that looked like that?
C. Yeah.
I. Whose house?
C. ------- down the street ------ like that.
I. Is that what you were thinking about when you drew this picture?
C. Um-hm.

#32 - YWF

I. I see. What were you thinking about when you drew that

picture?
C. About our garden last year.
I. Oh, you had a garden last year. Was the fence that you drew that you still have at home around that garden last year?
C. No, it isn't. We didn't have no fence.
I. This year you have a fence.
C. Yeh.

I. Really? How did you know how to draw such a nice fence?
C. We was playin with a fence that was little and I looked at it and then I thought I could make a fence like this ------
I. Does that fence look like a fence you've seen?
C. Yeh, one that I have at home.

#50 - OWM

I. What are you thinking about?
C. I was just thinking about how ------
I. How the what?
C. How a real garden would look.
I. Um-hm.
C. That doesn't look like it.
(drawing)

#39 - OWF

I. Do you have a tree in your yard like this?
C. We have three trees.
I. Do they look like that tree?
C. Um-hm, one of them does.

I. You have one row of flowers. That's very nice. Is there anything else you can tell me about any of your drawings that we haven't talked about, how you drew them, what you were thinking about?
C. In the first two pictures, jumping rope and running downhill I thought -----, the other two I thought of my house and my friend's garden.
I. Oh, this is your friend's garden, not your garden.
C. um-hm.
I. Do you have a garden?
C. We used to ------

#34 - YWF

I. Well how did you know how to draw a picture of your school?
C. Well sometimes we walk around the whole school but today we didn't.
I. What part of the school is that that shows in your picture?
C. The front.
I. That's the front of the school? Is there a tree near the front of your school like that?

C. I just thought I'd put a tree.
I. Anything else you want to tell me about your picture?
C. No.

#20 - YBF

I. Well how did you know how to draw a picture of a barn?
C. I don't know.
I. What about the tree? How did you know how to draw a picture of a tree?
C. Because I have a tree in my yard.
I. You do? Does that look like your tree? in your yard?
C. It's bigger.
I. Which tree is bigger?
C. My tree.

#41 - YWF

I. How did you know how to draw that?
C. I just thinked.
I. I see. Have you ever drawn it before?
C. No.
I. What were you thinking about?
C. I was thinking about what I would draw.
I. Were you thinking about a garden that you know of?
C. Um-hm.
I. Which garden is that?
C. My garden.

#29 - OWF

I. Does your garden look like that at home?
C. We don't have a garden.
I. Your grandfather's garden.
C. Yuh.
I. Looks like that?
C. Kind of.
I. Is that what you were thinking about when you drew your picture?
C. Yuh.

I. Now, about your garden. What were you thinking about when you drew the garden?
C. Well my paw-paw ---- we usually go out ---- back here, and he has ----- like here's the house and up here is the garden. And he has a big old fence -----
I. Does the fence look like that?
C. Yuh, we also have a wooden fence that kind a looks like that.
I. Is that supposed to be a wooden fence?
C. Yuh.

I. Tell me about your garden. Uh- oh, back to the house a minute. What were you thinking about when you drew the house?
C. Well, not our next door neighbor but their next door

neighbor has a house that goes like that, but it doesn't have a tree beside it.

I. Um-hm, so you were thinking about your neighbor's house?
C. Not my neighbor's, next door to my neighbor.
I. And it looks something like this?
C. Yuh, ------ tree.

#41 - YWF

I. Oh, is he planning to eat him? If he could catch him. How did you know how to draw that?
C. I thought.
I. You thought, you thought what?
C. I thought how to draw him, I looked at that picture.
I. Oh you were drawing that owl over there on the wall. Is that what you were looking at? Have you ever drawn an owl before?
C. No.
I. No? Have you ever drawn a fox before?
C. No.
I. How did you know how to start? Just by looking at that picture over there?
C. Um-hm.

#32 - YWF

I. Yes, how did you learn how to draw flowers so nicely? such pretty ones?
C. Because Mrs. Martin (teacher) showed us some pictures.
I. Oh, she did and you copied the pictures?
C. Yeh.

#52 - OWF

I. And then put the fence around it. Is there anything else you can tell me about your pictures, what you were thinking about when you drew them. When you drew the boy running did you think about the picture I showed you?
C. No.

I. Tell me about the house. How did you know how to draw a house?
C. From that artist's picture.
I. Oh you were thinking about that picture I showed you.
C. Um-hm.

I. Would you be thinking about somebody you'd seen digging in a garden?
C. um-hm.
I. No, a picture of someone digging in a garden.
C. Um-hm.
I. Yes?
C. um-hm.
I. Ok, where have you seen a picture of someone digging in a garden?
C. In a magazine.

#12 - OWM

I. He's going to put beans in that row? Right in the middle here, between the tomatoes and the watermelon. Ok, now how did you know how to draw a picture of a person digging.
C. I've seen one before.
I. You've seen a picture or you've seen a person digging?
C. A person and a picture.
I. Were you thinking about the person that you've seen digging or were you thinking about a picture that you've seen?
C. A picture.
I. What picture was that?
C. One I have at my house. I have it up in my room.
I. Oh, you have a picture of a person digging in a garden in your room. Who drew the picture?
C. I don't know. My mother got it at the store.

#50 - OWM

C. I learned somethin the other day when I came in here.
I. What did you learn?
C. That I drew my eyes wrong.
I. Oh, really, how did you find out that?
C. Cause I looked at the pictures that that person did and they drew 'em like that and I was always drawing them like a round ------- (drawing). I'll draw his hands ------ (drawing). That's the pile of dirt.

#1 - OBM

I. Ok, now tell me about your house. How did you know how to draw a house? with a tree in front?
C. You showed me that picture the day I came in.
I. Oh, were you thinking about that picture I showed you?
C. Yeah.
I. Were you thinking about that picture of the runner?
C. Yeah, I drawed the legs bent and I --------
I. You tried to draw the runner's legs like that picture.
C. Yeah.
I. And you were thinking about that house when you drew this house.
C. Yeah, and then I put the tree ------ the limbs ------- and then I put the nest in it.

APPENDIX G. ELABORATE ASSOCIATIONS

#49 - YBF

I. What were you thinking about when you drew that picture?
C. Making him run to the house.
I. Running to the house? Okay, what else were you thinking?
C. Cause the telephone was ringing.
I. Oh, he was running to the house because the telephone was ringing. Have you ever done that when you were outside? Had to run in to get the phone?
C. (inaudible)
I. You have. Did you think about how a person looks when they're running?
C. (inaudible)
I. You did? Were you thinking about any particular person that you know?
C. No.
I. No? Were you thinking about yourself running to get the telephone.
C. (inaudible)

I. You were? Ok, tell me about the person jumping rope. How did you draw that?
C. The girl was talking (?) to another person.
I. The girl was what?
C. That girl was talkin to another person ----- and the other girl was waiting.
I. Which girl was waiting?
C. That one.
I. This girl was talking to somebody else while this one was waiting. (girl on left talking to somebody else, girl on right, waiting) What about the girl in the middle?
C. (inaudible)
I. Waiting for what?
C. For the girl to turn the rope.

I. I want you to draw whatever you would like to draw. Anything that you would like to draw. (drawing) And tell me about your drawing, what you're doing. Looks like a house. And what are those?

C. They're lookin out the window at the flowers.
I. Who, where are the people looking out the windows. Point them out to me, the people who are looking out the window.
C. Those.
I. Is this a person, right there in the window? And you just see the person's head, is that right? Is this another person in another window?
C. Um-hm.
I. And this is another person in another window? And how about this?
C. Another person.
I. Another person at another window. Ok. So each window in your house has someone looking out of it. Is that right?
C. um-hm.
I. Ok, and what's that?
C. The door.
I. Door, ok. That looks like a flower. Is that the flower that the people are looking at?
C. Um-hm. (drawing)
I. What pretty flowers. You've got lots of flowers in your picture. Ok, tell me more about your picture.
C. They're lookin at all the flowers. First, she was diggin in the ground, then she went back in the house, then she stayed in the house, and then she came back out with the flower seeds and started putting them in the ground.
I. The one on the left you drew first, digging. And which one went into the house?
C. That one --------
I. Uh-huh, is this a different person? on the right. And she's going to plant that flower?

#41 - YWF

I. So you've never seen a real orange tree.
C. No.
I. But that's why you put in an orange tree? How did you know what they look like?
C. Well I saw some oranges when my mama bought some.
I. Oh, so you just pictured how they would look on a tree. Have you seen a picture of an orange tree?
C. No.
I. Do you have a garden at home? Is it like that?
C. It doesn't have an orange tree but it has an apple tree.
I. Oh.
C. And carrots.
I. It has an apple tree and carrots, but not the orange tree. Well who is that digging in the garden?
C. My mama.
I. Does your mama look like that?
C. She's got curly hair and she looks like that.
I. Um-hm, does she dig in the garden very much?
C. No.

I. Does she dig in the garden at all?
C. Sometimes.
I. And you were thinking about how she looks when she digs in the garden?
C. Um-hm.
I. Ok. And what else were you thinking about?
C. I was thinking about the orange tree and I was thinking about when I'm going to Florida ------------
I. You're going to Florida?
C. I'm going to Florida next August.
I. Oh, you are. Have you ever been there before?
C. No.

#19 - YBM

C. I'm drawin a car.
I. Ok.
C. And a ------ jumpin around.
I. All right, and what's that?
C. The tire.
I. That's the tire. Ok. You're drawing that first. And then the other tire.
C. The other rim. (drawing) That's the bottom of the car, and here's the top.
I. You're drawing the bottom of the car and then the top.
C. And then the ramp.
I. The ramp, ok. At the bottom of the page.
C. He jumped it, and then he turned around, and then he started from ------------- and something there is leaking.
I. Those things at the bottom are gas leaking?
C. Um-hm.
I. Why is gas leaking from the car?
C. He been drivin it too much.
I. Oh (drawing) What's that?
C. The grass. (drawing)
I. Ok, tell me about your picture. What are you adding to the picture now?
C. I'm makin a ten, Duksa has it.
I. That's the what?
C. Duksa has it.
I. Duksa?
C. Duksa has it.
I. I don't understand what that means.
C. Like if they use two men, they drive a racing car and they be goin fast and they jump ------- and they have a ten on the side.
I. Oh, that's a ten.
C. And they have a ten on the side of the door. And this man who's driving the car, his name is --------- and the other man that sits on the other side of the seat his name is Luke. But they call him Luke, Duke.
I. Oh.

C. But his real name is Luke.
I. Tell me about the ramp and the car.
C. See these two men, they jump ramps all the time.
I. Oh, do you know these men?
C. Yeh, they be on TV.
I. Oh, you've seen them on TV. Now has that car just jumped off that ramp?
C. Yeh.
I. Or is it going to jump off the ramp?
C. It just now jumped off.
I. It just jumped off, and where is it going to go next?
C. It's gonna hit the ground and then and then they gonna ride it again on the tires.
I. Oh. Where are the men? I don't see them.
C. They inside of the car.
I. But you can't see them.
C. Yeh.
I. How did you know how to draw that?
C. I just, you know, copied it, copied the car.
I. From where?
C. On the show.
I. You mean from watching the show?
C. Yeh.
I. Have you ever drawn that before?
C. No.
I. You mean you just sat here and thought about what it looked like on TV? And then you drew it.
C. Yeh.

#39 - OWF

I. All right tell me about your garden.
C. My grandmother and the people who live two houses down have a flower garden and they have ------- that was skinny and ----------- to keep the cat and the dog out.
I. What was skinny?
C. The flowers.
I. The flowers were skinny?
C. And the garden, the size of the garden.
I. The garden was skinny.
C. Um-hm.
I. And the flowers were skinny.
C. um-hm.
I. Is that what you drew?
C. um-hm, sort of.
I. Did you try to draw a garden that looked like that garden?
C. um-hm.
I. Were you thinking about that garden?
C. Um-hm.

#1 - OBM

I. What were you thinking about when you drew the garden?
C. I planted a garden in back of my friend's house. His name is Michael and he got a brother named Terry ------- made a garden ------
I. Does it look like that garden?
C. We was going to build a fence around it except we just dug a hole ------- and then we planted --------- corn seed and bean seed ------ and some flower seeds --------------
I. So did your garden turn out to look like that after you got thru planting?
C. No, I didn't put a fence around it.

C. Yeah, --- they got a wooden fence, the wood got holes in it and they got the sticks standing on top of it.
I. What fence is that you're describing?
C. The one at the park.
I. Oh, the one at the park. Is that what you were thinking about when you drew this?
C. I was ----- put a fence around the garden at home except when I drawed this garden I was thinking of my garden but with a fence around it.
I. I know, but I mean the fence you drew, were you thinking about the fence at the park when you drew this fence?
C. Yeah.

#29 - OWF

I. Then you drew the seed, and then you drew the person and his shovel and he was digging. Now how did you know how to do that?
C. Well I go down to my grandfather's house, I go down there a lot -------------- and I went up there and watched him cause I didn't have nothin else to do except play with ---------- he's got a big ole --------
I. Oh.
C. I used some of my imagination and I thought about what my daddy looked like --------
I. Is that person in your garden supposed to be your daddy or your grandfather?
C. I don't know.
I. Were you thinking of either one of them. Which one were you thinking of?
C. Probably my daddy.

#49 - YBF

I. Does it look like anybody's house that you know?
C. (inaudible)
I. Well, what were you thinking about when you drew this

house?

C. I was thinkin that it was someone who moved out of their house.

I. Someone who moved out? Why?

C. Cause they ----------

I. They wanted what?

C. They didn't want to live in it any more.

I. Why not?

C. They wanted to move into another place so they could --------- with their cousins who live there.

#29 - OWF

I. Do you always draw them (girls jumping rope) on a hill?

C. Sometimes. And then when I was in the second grade something terrible had just happened and I went down to the counselor's office and she let me draw anything I wanted to and there was a girl up there who was sick and her mother and father weren't home and she had no way to go home so the teacher sent her up there and the counselor made her feel better. She had drawn a ----- kind a like a hill -------- so from then on I decided ----------

I. Now wait a minute, you got the idea of making a hill like this from her picture of the sun.

C. -------------- at the bottom of the page she drew that and then that and then put her sun coming up.

I. Oh like just coming over the horizon?

#50 - OWM

I. Are you thinking what to put next?

C. Um-hm. Okra.

I. Okra?

C. um-hm. We have okra in our garden too. (drawing) I'm not saying it grows like this but- one time, last year that's all Paw planted in the garden was okra. And we have a big old garden, about as big around as- see there's a big old field over there where we live and we're fixin up our house and we bought some property offa the field and it's a big part of the property and we plowed it up and we found a horseshoe, a bunch of -------- and he found a nickel that had an Indian on it and a buffalo on it- an old one. And he planted okra and everything. We found a lot of copperheads too. And he killed four copperheads in one day.

I. Who is he?

C. My grandfather.

I. Oh.

C. I call him paw. He killed four copperheads in one day and let me have one. And I let him ----- (drawing). And he showed me how to hold the copperheads to hold any giant snake really (drawing).

#34 - YWF

I. I'm going to give you another piece of paper and I want you to draw me a picture of anything you like, anything that you would like to draw and tell me about it as you draw.

C. ----------- school ----------

I. That's Peck School. (drawing)

C. Peck School. Here is a bush and trees, and here's the -------- and here's the principal, Mr. Best, and here is -------- and over here would be me.

I. You're over there near the tree.

C. And here's my little sister and my mama. My hair was real long, she would probably have it in a pony tail so I wouldn't get real hot (rest is inaudible).

I. Well tell me about your picture.

C. My mama forgot to bring my sister in when I was playing and here is my mama in the school trying to figure out to go in but she wouldn't know

I. Was she looking for you at school?

C. No, she was looking for a room, like she forgot the way the first grade and kindergarten --------- she forgot which way to go. And then here was the principal ---------- and she went on in the school to talk to my teacher a minute -------------- When I went out to play on the playground (long unintelligible passage).

APPENDIX H. PARTICIPATING IN SCENE

#32 - YWF

I. And how would you make it look like she was digging?
C. All I could do was make her just like she's bending over and she's puttin some seeds inside of it.
I. And what else would you do?
C. I would first dig the holes and then I'd put the seeds inside.
I. You'd do what to the holes?
C. First I'd dig the holes.
I. Ok, first you'd dig the holes.
C. Then I'd put the seeds inside. Then I'd keep on watering them when it's sunny and hot and when it rains I don't need to water them.

#19 - YBM

I. Tell me how would you draw a picture of a person digging in a garden?
C. Get a shovel and dig in the ground.
I. Well how would you draw that?
C. Put a man with a work hat and have a shovel in his hand and digging in the dirt.

#58 - YWF

I. um-hm. Now how did you know how to draw a picture of a person digging in a garden?
C. I saw my uncle do it.
I. Oh, you did. Well, what did he do?
C. He made a garden and put some vegetable seeds in it and they grow and he picked them out.

#34 - YWF

I. He's facing the seeds? Ok. How did you know how to draw a picture of a person digging in a garden?
C. Usually we do drawings every day and even today but we started something else ------- My mama might let me get a little shovel so I can dig in a garden but I don't know if she'll let me but tonight we have to look at a house and we might dig a garden and my daddy might help me ------- How I knew how to draw a garden, somebody that I know has a garden, lives

beside my baby sitter and I knew how to draw a garden since I saw it every day I see how it looks. She's mostly out there real late in the evening digging

----

APPENDIX I. GEOMETRIC EQUIVALENTS FOR OBJECTS

#29 - OWF

I. What did you draw first in your garden?
C. I drew a square and lines and ---- draw the fence.
I. You drew the square and the lines which show where the things are planted. And then the fence.
C. Yuh.

#1 - OBM

I. Anything else that you want to tell me about your pictures, what you were thinking about or how you drew them?
C. Well when I first drawed this I just drawed around like that.
I. What, the fence?
C. No, the garden --------
I. You drew the garden first?
C. Yeah and then put the lines.
I. You drew the square and the outline of the garden.
C. Yeah, and then I drawed the lines in the garden ------ and then I put a fence around it.

#50 - OWM

C. The whole garden?
I. Well, where would you start? What part would you draw first?
C. Up here. I'd just draw a square like that.
I. A square?
C. Um-hm, and then I'd draw the stuff in it and leave a space for the man and the hole.
I. What would you draw in it? What kind of stuff?
C. Tomatoes and okra and corn and that's all.

#52 - OWF

I. And how did you make her look like she was smiling?
C. Her mouth, put the line in and drew it up in the air, then I put a straight line across it.
I. Well, how did you know how to draw one, what did you

do first?

C. I drew these wavy lines and then I drew this thing right here first and then put these.

I. You mean the fence?

C. I drew the outline, then I put the ------ and then I put the long lines.

I. First you drew the outline, and then the short lines and then the long lines to make your fence. Which did you draw first, the garden or the fence?

C. The garden.

#48 - OWF

C. I started with the legs ------ two straight lines and then I took a curve.

I. A curve rectangle to the body?

C. And I kinda put a hole on it so I could put the head to the neck ---- and then the eyes, nose, and the mouth. A dot for the eyes and a dot for the nose and the mouth ------ and then I put another one on like it's behind him, then I drew a ------ for the shovel, then I drew kind a like a circle and then I started drawing regular lines for the dirt and a big pile of dirt and a hole. ----- and then I made shoes.

I. And you made shoes. Ok. Have you ever drawn a picture of a person digging in a garden before?

C. No.

C. um-hm, and he's happy -----

I. He's happy?

C. Um-hm.

I. He likes digging in the garden. How do you make him look happy?

C. Put a smiling face on him.

I. Ok, and how do you do that?

C. I don't know, just put a little line ------

C. I'm going to try at least to draw a ------. First you make a half circle and then you make the other side of the half circle. And then put an arrow --------

I. Oh, you're drawing a heart.

C. (inaudible)

I. That's your favorite picture?

C. Um-hm.

#55 - OBF

I. You see the house and the tree. Ok, what about your garden? How did you know how to draw a garden?

C. Well my cousin, we used to play school, my cousin wanted to teach me, she told me to draw a garden and I got the flowers from this girl named Kathy and the tree I got that from my cousin.

I. Well what did Kathy tell you to do when she taught you how to draw flowers?
C. She told me, I watched her and she told me to make the circle and then go in little.
I. To make the what?
C. She told me to take the ink pen and go around in a circle like a circle like that.
I. The ink pen you said?
C. You start gettin littler and littler until it get like that.
I. Oh, I see what you mean.
C. And then make the leaves and the stem.
I. So you thought when you were drawing your flowers you thought about what Kathy had told you?

#48 - OWF

I. I see. What about the tree? How did you know how to place the tree?
C. I learned that in kindergarten.
I. What did you learn?
C. First I learned how to make the roots. My teacher had taught me how to make a tree just by going like this. Then in first grade I decided to try it like this.
I. Like what?
C. Like kind of down and curved at the bottom and she showed me how to make the ----- and the leaf part on the tree.

I. How did you know how to draw a heart?
C. My mother taught me.
I. She did? What did she tell you to do?
C. She told me to draw an N and then make two lines down.
I. An N? And make two lines, where are the two lines?
C. --------- down to the bottom of the page ------------ touching.
I. And where is the N.
C. At the top.
I. Oh, I see. The top part of your heart is the N and then the lines going down and meeting at the bottom.
C. Make the triangle.
I. They make the triangle, ok. Your mother taught you how to do that?
C. uh-huh -------------
I. How long ago was that?
C. When I was in kindergarten.
I. Oh, and you've been drawing hearts ever since?
C. Um-hm.
I. And you always draw them the same way.
C. Almost always, usually, sometimes I put the arrow and sometimes I don't.
I. What is the arrow supposed to be?
C. (inaudible)

I. I want to talk to you about your drawings. First let's talk about your people that you drew. A person running and a person jumping rope. How did you know how to draw a picture of a person running?

C. Well, when I was little my mama taught me how to draw a picture.

I. Your mama taught you how to draw a person.

C. Yeah and she helped me with the legs and I did them after that. She told me to draw a ------- a small "s" ---- for the legs and she told me to make a ----- for the neck and then she told me to erase part of the box and then she told me to make a circle for the head so I made a circle and she told me little and little l's for the arms.

I. That's very interesting. She told you to make "l's" for the arms and legs. That's very interesting. Look at the person running.

#29 - OWF

I. Do you always draw your figures the same way? No. Well how do you draw them sometimes when you want to do it differently?

C. Well, I can't remember what grade I was in but my cousin she used to draw people bowling, getting ready to bowl and I copied some of her pictures from that. What I would do is I would draw the head and then.

I. Do you want to show me on the paper?

C. Ok, I draw the head and then I draw kind of down right here and then I draw, just make a long thing and then I draw a long slanted thing like that.

I. The arms slanted down.

C. Then I divide the pants and make the shoes and then the last thing I would do is make the bowling ball. Well I don't draw the bowling ball but I draw people kinda like that too.

I. Then how did you learn to draw that kind of person?

C. My cousin, she used to draw people bowling and I asked her to teach me how to bowling and she did and then two months later I used to draw my mother, and my father and my relatives bowling.

#52 - OWF

I. No? How about the sun? How did you know how to draw the sun?

C. When I was in kindergarten we used to draw a sun every time we drew a picture.

I. You always drew a sun. Did somebody teach you how to draw a sun like that?

C. My friend.

I. What did she tell you to do?

C. She told me to draw this ----- in the right hand corner and the left hand corner and draw kind of a curved line around and then draw a smiling face just like I drew on the girl and then draw the eye and then draw speckles.

I. I see. Those lines coming out are the last things you draw.

I. How did you know how to draw a tree?
C. My cousin.
I. What did your cousin teach you to do?
C. Told me to draw this part out and take the other part and draw it around and then I just put the little lines in.
I. And what about the flowers? That looks like the flowers that you drew in the garden.
C. Yeh, my friend in my class showed me how to draw.
I. She taught you how to draw flowers like that? What did she tell you to do?
C. She told me to draw a straight line, then draw the leaves and then keep going around in a circle till you get ------

I. What did she tell you to do?
C. She told me to make a straight line and then make a leg and then go around and make it big ---------
I. Um-hm, like that illustration at the top of the page that you just made for me.
C. Yeah.
I. Ok, she showed you how to do that.
C. Yeah.
I. And who showed you how to make carrots like that. How did you know how to draw the carrots?
C. I learned it from my cousin.
I. What did she show you to do?
C. She showed me to make a straight line across, then go down and then put the other end, and go down, then start makin the line and then make the leaves.
I. Like the illustration at the top of the page.
C. Yeah, and sometimes she used to look at a carrot and try to draw it.

#57 - YWF

I. Tell me what you're doing while you're doing it.
C. (inaudible)
I. How do you make the front of the house?
C. You draw a square with a door and then draw a -----

I. How would you make the garden?
C. Make -------- dirt.
I. How do you make the dirt?
C. (inaudible)
I. Two bumps on each other?
C. Yes. That's all.
I. How would you make the person look like they were digging?
C. Make him have the shovel in a certain way, so they're digging out the dirt.

I. What certain way would that be?
C. I don't know.

I. How do you draw a carrot?
C. (inaudible)
I. (inaudible)
C. The top.
I. Does the ----- look like the rest of the carrot?
C. uh-uh.
I. What does it look like?
C. Like a circle.

#58 - YWF

I. The doggy and the house? How did you know how to draw a picture of a book?
C. My daddy taught me.
I. Really? What did he tell you to do?
C. He told me to make the back first, and then make the lines.
I. Is each line, what do those lines mean?
C. These is the pages.
I. Each line is a different page? and this is the back of the book?
C. Yeh.

APPENDIX J. OCCLUSION

#48 - OWF

I. Are you supposed to see the house thru the tree?
C. No.
I. Where is the tree supposed to be?
C. In front of the house.
I. So that it blocks part of the house?
C. Uh-huh.

#12 - OWM

I. So your tree covers part of the house, doesn't it?
C. Um-hm.
I. Where is the tree?
C. In the middle.
I. In the middle. Is it in front of the house?
C. Yuh.
I. So that it hides part of the front of the house.
C. Uh-huh.

#48 - OWF

I. What about the house and the tree. Did you draw the house first or the tree?
C. The house.
I. You drew the house first.
C. Um-hm.
I. How did you know to do that?
C. Because then I could make, I could erase half of it so I could fit the tree in.
I. That was a good idea. Does that roof go straight up or what?
C. It's supposed to.
I. It's supposed to go straight up.
C. Um-hm.

#1 - OBM

C. ---------- the jump rope when he holdin it.
I. The part that's in his hand is covered up.
C. Yeah.
I. You don't see that in the picture
C. No.

I. What did you draw first when you drew the jump rope figure, the feet, you said?
C. Yes, the feet.
I. And then what?
C. The shirt and arms, and then the rope, and then his hands.
I. You drew the rope and then you put in the hands.
C. No, first I drew the rope like blocks and then I made a hand and then put in the other side of the jump rope, like he was holding it in his hand------- covered up.
I. What's covered up?

#48 - OWF

I. Oh, I see, if you had a thick piece of paper.
C. If I had some.
I. What about your garden?
C. Down in the country we have a garden ------------- have one every year. We have like this is the dirt, the wavy stuff and the little lines is the little leaves and the -------- and here is the little seeds and the -----------
I. Where those dots are? underneath the plant are the seeds.
C. The seeds are underneath the dirt.

#1 - OBM

I. Is that fence standing up?
C. Yes, it looks like it's laying down because it's a drawing. If it was a real fence it would be standing up.
I. I see, but because it's a drawing it looks like it's lying down.
C. Yes.
I. How could you get that to look like it's standing up?
C. (pause) Draw it over like this, to the garden.
I. What do you mean?
C. Draw it on the garden.
I. If you drew it on the garden it would look like it was standing up.
C. Yes, just draw a fence -----------
I. Oh, if you had drawn it right on top of the garden it would look like it was standing up? Is that what you mean?
C. What I was thinking about was drawing a little ---------- and making a fence go around straight across like this ----------- and then I just --------- around like this --------------------

#12 - OWM

I. Anything else you want to tell me about these people? No. Now tell me about this house. How did you know

how to draw a house with a tree?

C. I started to put the house behind the tree but I erased the top of the house and the bottom and put the tree in front--the house and then had the little ------- on the side.

I. No? What's growing in your garden?
C. Tomatoes, and beans, okra, and cabbage.
I. Where are those vegetables?
C. Inside the garden, in the ground.
I. They're in the ground, the seeds you mean? So all you see in your picture is the rows, where they were planted.
C. Um-hm.

#1 - OBM

C. Right here. These ------- (pointed to sides)
I. Where is the back of the house?
C. Right here, right on the side of this, right here.
I. Can you see it in your picture?
C. No.
I. How come?
C. Cause I drawed the sides and the front, but I didn't show the back of it.

#43 - YBM

I. What is that?
C. It's a duck face.
I. A duck face?. all right.
C. His eye. His other eye. The other eye's on the other side.
I. The other eye's on the other side but you don't see it. So you're looking at the side of his face?
C. Yep.
I. If you turned over the picture you'd see the other side, right?
C. Um-hm.

#52 - OWF

I. You mean someone else running. Were you thinking about anybody in particular that you know? No? You've seen people run, haven't you? Were you thinking about how they look when they run?
C. Uh-huh.
I. And is the arm in a place where we can't see it? Is that why it doesn't show in the picture?
C. Uh-huh, it's on the other side.
I. It's on the other side.

I. That's one arm. Where's the other arm?
C. ------------ I think I was supposed to put a little ------------ over here.

C. Uh-huh.
I. All right. Look at the picture of the person jumping rope. How did you draw that picture?
C. Her legs are behind her and this is her knees.
I. Oh, I see. The lower part of her leg you don't see in the picture.
C. No because she- her legs are up in the air behind her.
I. Oh, so that's when she's actually jumping and in the air. And where is the jump rope?
C. Under her --------
I. Under her legs.
C. Uh.
I. Is it touching the ground?
C. (inaudible)
I. Yes? Ok. Are her legs together or apart?
C. This part of them is together. Her pants are together but her knees aren't.

#55 - OBF

I. Um-hm. And what is this line? You say that's to keep people out.
C. Yeah.
I. Well what is there to keep people out?
C. Keep people from out of the garden cause they won't step on the flowers and the vegetables.
I. Is it a fence or what is it there to keep people out?
C. It's a fence.
I. Oh, ok, is your fence standing up?
C. Um-hm, it's around.
I. Does it go all the way around the garden?
C. Um-hm.
I. How much of it shows in your picture?
C. Half of it.
I. Just two sides.
C. Um-hm.
I. What would happen if you had drawn all four sides?
C. Then you would know the difference.
I. You would know the difference?
C. From half of the side and whole.
I. What would it look like if you had drawn all four sides around the garden of the fence?
C. It would look like a real gate around it.
I. Would you be able to see the person digging?
C. Yeh.
I. How.
C. By putting the person somewhere where you could see it and where other people could see it.
I. Could you put the person right there and see if you'd draw a fence all around the garden?
C. um-hm.
I. You could see the person there?
C. Um-hm.
I. How?

C. Cause when you draw it all the way around then the person would still be in the garden digging.
I. But how could you see the person through the fence?
C. By it'd be a little door right there and she can walk in, and then she can lock it up, lock it back until she finish and then nobody can get in.
I. So you just added a door.
C. Yuh.
I. To your fence, as we were talking. Anything else you want to tell me about the person digging in the garden?
C. um-hm.

#58 - YWF

I. The doggy and the house, ok. Is that the name of a book you've read?
C. (inaudible)
I. All right, now how would you open that book? Where's the front cover?
C. Right here and this is the back cover.
I. Right.
C. And here's the pages.
I. This right here is the front cover?
C. No.
I. No, you told me that was the back. Where is the front cover of your book?
C. That's the back, and this is the front cover.
I. Oh (when asked where the front cover is she drew a vertical line on the right hand side of the book, and opened the book by picking up that right hand line). And how would you open that book?
C. Open the cover and there's the pages.
I. You just pull that? Ok (open book by pulling that right hand line). And what did you say was on the other side?
C. The cover and here's the cover, and the inside is the pages.
I. What's on the other side. You picked up the paper a minute ago and you said something was on the other side.
C. The out cover.

#32 - YWF

I. Ok what would you do to make that a better picture?
C. I'd put the feet right over here and the head right over there, so all you can see is the side.
I. Oh, you would draw him so that you could only see his side. How would you do that?
C. I'd get--um--I'd ---- a box and I'd draw it just like this, the back, I'd draw the side this-a-way and the back and the other side that-a-way in the box.
I. You would draw a box? Is that what you said?
C. No, I'd get a box.
I. You'd get a box and then what would you do?

C. I'd put the side this-a-way the front of the box and then I'd put the other side on the back of the box.

I. The other side of what? the person?

C. Uh-huh.

I. On the back of the box. And that would make him look like you were just showing one side of the person? Have you ever done that?

C. I couldn't find no box and I didn't have any pencil at home but I did one time at my other school.

#48 - OWF

I. What side of the house do you see when you look at the picture?

C. The front.

I. Where's the back of the house?

C. It should be on the other side of the paper.

I. How come you can't see it in your picture?

C. Cause I didn't draw it.

I. You didn't draw the back. What about the sides of the house?

C. You can't see it because -------

I. If you had what?

C. If you had a real thick piece of paper you could draw the side.

APPENDIX K. CONVERGENCE

#48 - OWF

I. Let's look at these pictures of a house and a garden. How did you know how to draw a house?
C. A long time ago-------triangles---------and I decided I should make some squares so I made some squares and put them together with a triangle and made the house like that. It's not like this house but a different kind, just like a rectangle house. Then my daddy, he taught me how to make the roof like this and the chimney like this, and then the windows, the rectangles a window and a door.
I. What did your daddy tell you to do?
C. My mama and my daddy helped me to make the roof on houses like this.
I. What did they tell you you should do?
C. To first make a rectangle and then try to erase it and make the slant and then make a ------- and another slant down here ----------- the edge.

#50 - OWM

I. Tell me about your fence. Why does it look different on the four sides? Can you explain that?
C. Cause you're lookin at it up with an angle.
I. You're looking at it with an angle.
C. Uh-huh, and this right here would not be up, it'd be over like that and this would be over like that. And that would come up like that. And I messed it up.
I. Is that so that you can- does your fence look like it's standing up?
C. Um-hm.
I. It does. And how did you make it look like it's standing up?
C. Put it with a angle.
I. Cause you drew it at an angle?
C. Uh-huh. Well some people would think that it was laying down if they looked at it -------- like that, but you gotta look at it a certain way.

I. Which way do you have to look at it?
C. I look at it like this way. If you look like it up here it looks like it's lying down.
I. Yes. So you sit back here and you look at it-
C. That way, only from the bottom up.
I. From the bottom up to the top. And that looks like it's standing. Yes I see where you drew it at an angle. You mean on the sides. You drew it at an angle.
C. I messed up.

#32 - YWF

C. I couldn't make it ---------
I. You what?
C. I couldn't make it like other people's fences.
I. You couldn't make it like other fences? Why not?
C. Cause the sheet weren't big enough.
I. Oh, the sheet wasn't big enough, ok, ok.

#29 - OWF

I. Is your fence standing up?
C. Well, not really, but if you stood the picture up you can see it standing up.
I. If you stood the picture up you could see your fence standing up.
C. I think so.
I. You think so.
C. Part of it you can.

#20 - YBF

(drawing)
C. (inaudible)
I. Don't forget about your person digging in the garden.
C. I have to make her, I can't make her stand up.
I. The person?
C. I'll make her laying down.
I. Why, he wouldn't be lying down if he was digging would he?
C. I'll do like that. (somewhere in here she held up the paper vertically and said "I have to make her standing up.")

#12 - OWM

I. Is your fence standing up?
C. Yup.
I. Does it look like it's standing up?
C. Uh-uh.
I. What does it look like?
C. Laying down.
I. Why do you think that is?
C. ------------- I don't know how to draw a fence up.

I. You don't know how to draw a fence up so your fence looks like it's laying down. Can you think of a way you could draw it so it looks like it's standing up straight?
C. um-um.

#55 - OBF

I. All right, where is your fence?
C. Right here. (pointed to bottom of picture)
I. That's your fence. Ok. And show me the four sides of your garden.
C. Right here, right here, right here, and right here. (pointed to the corners of paper)

#39 - OWF

I. Where is your fence?
C. Around the garden.
I. Can you show it to me on the picture?
C. (inaudible)
I. Oh, I see, those are your four side-poles (pointed to four things in corners, strip at bottom is fence between poles). Does your fence look like it's standing up?
C. No in the picture it don't look like it, if it were a real one it would.
I. How could you make it in the picture look like it's standing up?
C. (inaudible)
I. You mean you would pick up the bottom pole and have it-is that what you're saying?--meet the top pole and it would look like it was standing up.
C. Um-hm.
I. When you say pole what do you mean?
C. (inaudible)

#48 - OWF

I. Ok, does your garden look like that except for the fence?
C. Yes.
I. Now, does that fence stand up straight?
C. It's supposed to.
I. Does it look like it's standing up straight?
C. No.
I. What does it look like to you?
C. It looks like it's falling down.
I. Why do you think that is?
C. Because you can't ----------
I. Oh.
C. You can't draw anything and make it stand up.

#32 - YWF

I. So what makes the fence look like it's standing up?
C. Cause of all these lines.
I. Which lines are those?

C. The fence, where nobody can get out of it.
I. Which lines are the ones you drew to make it look like it's standing up straight?
C. These.
I. These going across or up and down?
C. These.
I. Going across like that.
C. Um-hm.
I. And that makes the fence look like it's standing up?
C. Um-hm, if it laid down it would be flat.

APPENDIX L. POINT-OF-VIEW

#50 - OWM

I. Tell me about your fence. Why does it look different on the four sides? Can you explain that?
C. Cause you're lookin at it up with an angle.
I. You're looking at it with an angle.
C. Uh-huh, and this right here would not be up, it'd be over like that and this would be over like that. And that would come up like that. And I messed it up.
I. Is that so that you can--does your fence look like it's standing up?
C. Um-hm.
I. It does. And how did you make it look like it's standing up?
C. Put it with a angle.
I. Cause you drew it at an angle?
C. Uh-huh. Well some people would think that it was laying down if they looked at it -------- like that, but you gotta look at it a certain way.
I. Which way do you have to look at it?
C. I look at it like this way. If you look like it up here it looks like it's lying down.
I. Yes. So you sit back here and you look at it.
C. That way, only from the bottom up.
I. From the bottom to the top. And that looks like it's standing. Yes I see where you drew it at an angle. You mean on the sides. You drew it at an angle.
C. I messed up.

#52 - OWF

I. So all you've drawn is the garden when it was first planted. And how did you get the fence to look like it was standing up? Does the fence look like it's standing up?
C. (inaudible)
I. What does it look like?
C. It looks like it's flat.
I. How could you get it to look like it was standing up?
C. Show it from up above. ------------------
I. I see. Which part would show if you drew it from above?

C. The top.
I. The top part. You've seen a garden like that with a fence around it.
C. (inaudible)

#32 - YWF

I. Ok what would you do to make that a better picture?
C. I'd put the feet right over here and the head right over there, so all you can see is the side.
I. Oh, you would draw him so that you could only see his side. How would you do that?
C. I'd get- um- I'd --- a box and I'd draw it just like this, by the back, I'd draw the side this-a-way and the back and the other side that-a-way in the box.
I. You would draw a box? Is that what you said?
C. No, I'd get a box.
I. You'd get a box and then what would you do?
C. I'd put the side this-a-way the front of the box and then I'd put the other side on the back of the box.
I. The other side of what? the person?
C. Uh-huh.
I. On the back of the box. And that would make him look like you were just showing one side of the person? Have you ever done that?
C. I couldn't find no box and I didn't have any pencil at home but I did one time at my other school.

#50 - OWM

C. (moan) (drawing) drew it from ----- You'd see it from the inside.
I. You'd see it from what?
C. The inside.
I. You'd see what from the inside?
C. The fence.
I. You'd see the fence from the inside of the garden?
C. Yeah, on that side. (pause)

#48 - OWF

I. What side of the house do you see when you look at the picture?
C. The front.
I. Where's the back of the house?
C. It should be on the other side of the paper.
I. How come you can't see it in your picture?
C. Cause I didn't draw it.
I. You didn't draw the back. What about the sides of the house?
C. You can't see it because ---------
I. If you had what?
C. If you had a real thick piece of paper you could draw the sides.

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1971 Bachelor of Arts with honors, Fine Arts Department University of Illinois at Urbana

PAPERS AND PUBLICATIONS

Bordeaux, J. D. Developmental delays in intellectual functioning resulting from treatment of childhood cancer. In D. R. Copeland, B. Pfefferbaum and A. Stovall, _The mind of the child who is said to be sick_. Springfield, Ill.: Charles C. Thomas, in press.

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EMPLOYMENT

1981 - Research Assistant II. Department of Pediatrics, U.T.M.D. Anderson Hospital. Investigation of the effects of cancer treatment on the neuropsychological development of pediatric patients.

1979 Lecturer, Department of Psychology, Duke University

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HONORS

1980- 1978	Graduate Research Awards, Duke University
1976	Graduate Fellowship, Duke University
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